TEXAS Geosciences
The University of Texas at Austin
Jackson School of Geosciences

ENERGY AND EARTH RESOURCES GRADUATE PROGRAM

Energy Transition: Agents of Change, Changing Agents

Getting There: Energy Leadership in Unprecedented Times

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photo credit: Dave Leary

A perspective (market cap; pre-market, April 13, 2021)

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Microsoft		$1940 B
Alphabet		$1520 B
TESLA		$697 B
ExxonMobil	$233 B	$777 B
Chevron	$196 B	
	$147 B	
TOTAL	$118 B	
	$83 B	
TOYOTA	$252 B	

“The future ain’t what it used to be” – Yogi Berra

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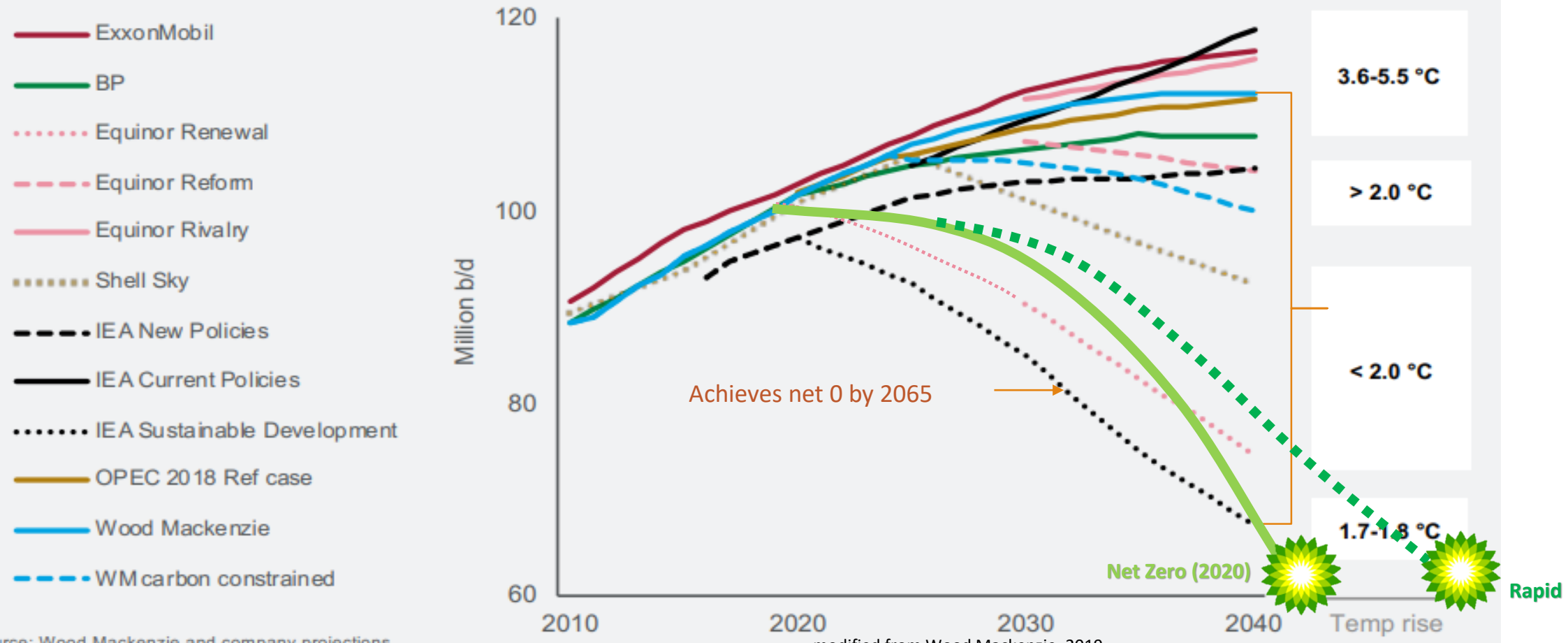
- Wood Mackenzie Carbon Constrained vs. IEA SDS (or BP Net Zero) represents a difference of ~45 MBD of oil production in 2040



Source: Wood Mackenzie and company projections.

modified from Wood Mackenzie, 2019

WM carbon-constrained scenario

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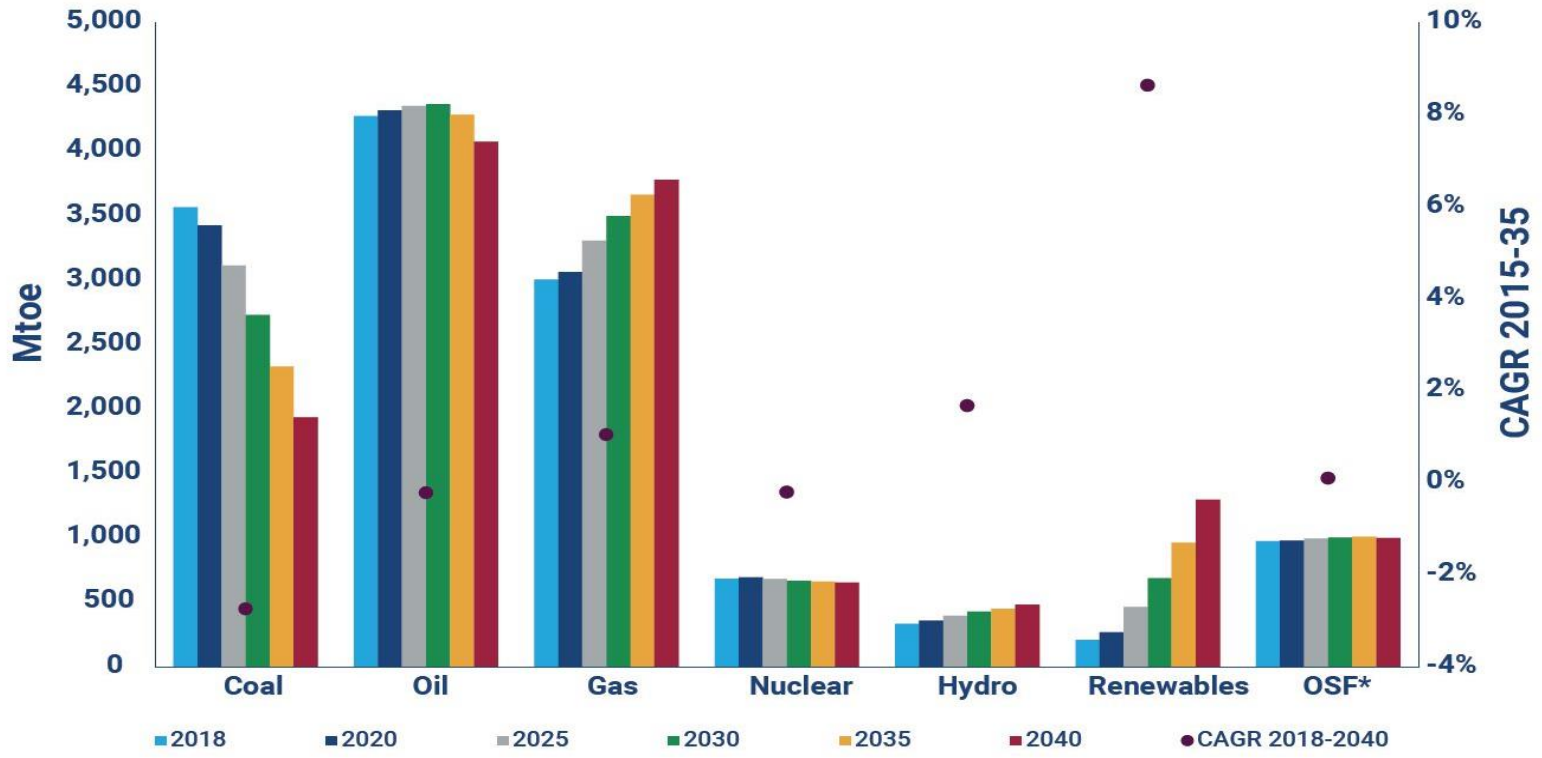

WoodMackenzie, 2018

Carbon-constrained scenario (2040):

- ***100% of new vehicle sales in U.S / Europe are electric by 2040***
- ***40% of power met by wind and solar in 2035***
- ***EVs displace 11 mbpd of oil demand***

- **Fossil fuels provide ~75% of energy in 2040 (85% in 2018)**
- **Greatest CO_2 benefit will come from mitigating emissions from fossil fuel combustion**

The process

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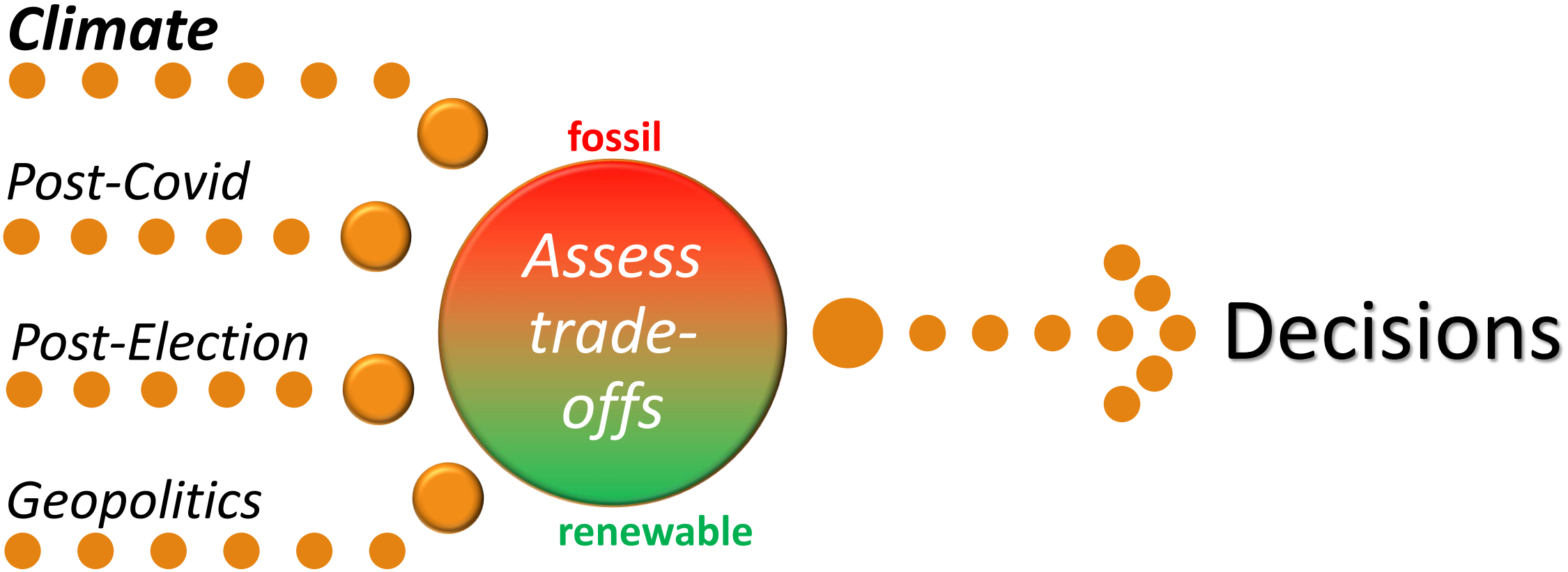

"As for the future, your task is not to foresee, but to enable it." - Antoine de St. Exupery

Key considerations

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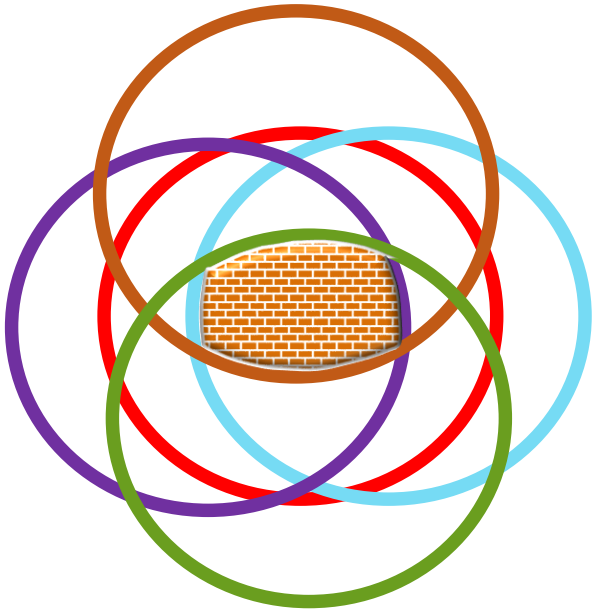
Solving three simultaneous equations:

$f(x_1)$ = sound science and technology

$f(x_2)$ = consistency with policy which adequately addresses the welfare of society

$f(x_3)$ = financial viability to attract the interest of investors

= complexity (trade-offs occur in multiple dimensions)



Jackson (administrative home) / earth, atmospheric sciences

Cockrell / engineering

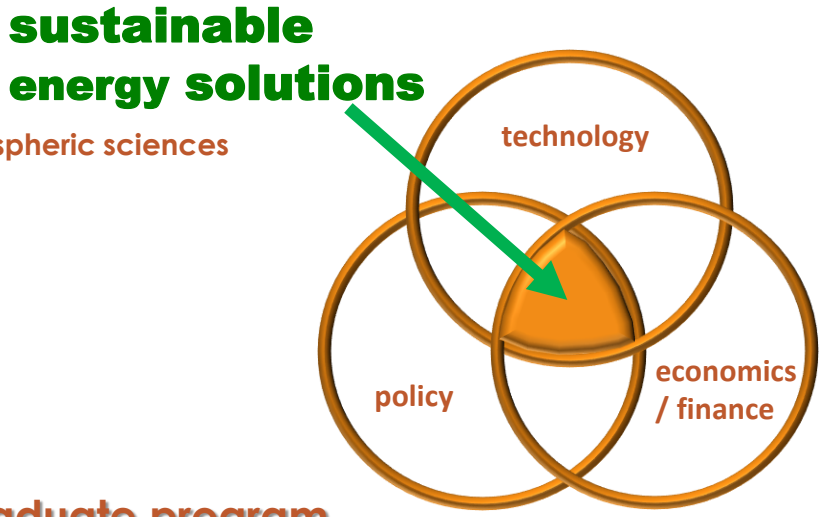
McCombs (dual MBA) / economics, finance

LBJ (dual MPAFF, MGPS) / policy

Law / law, regulation, contracts

\+ Energy Institute

Energy and Earth Resources graduate program



“Our intuition about the future is linear”

– Ray Kurzweil

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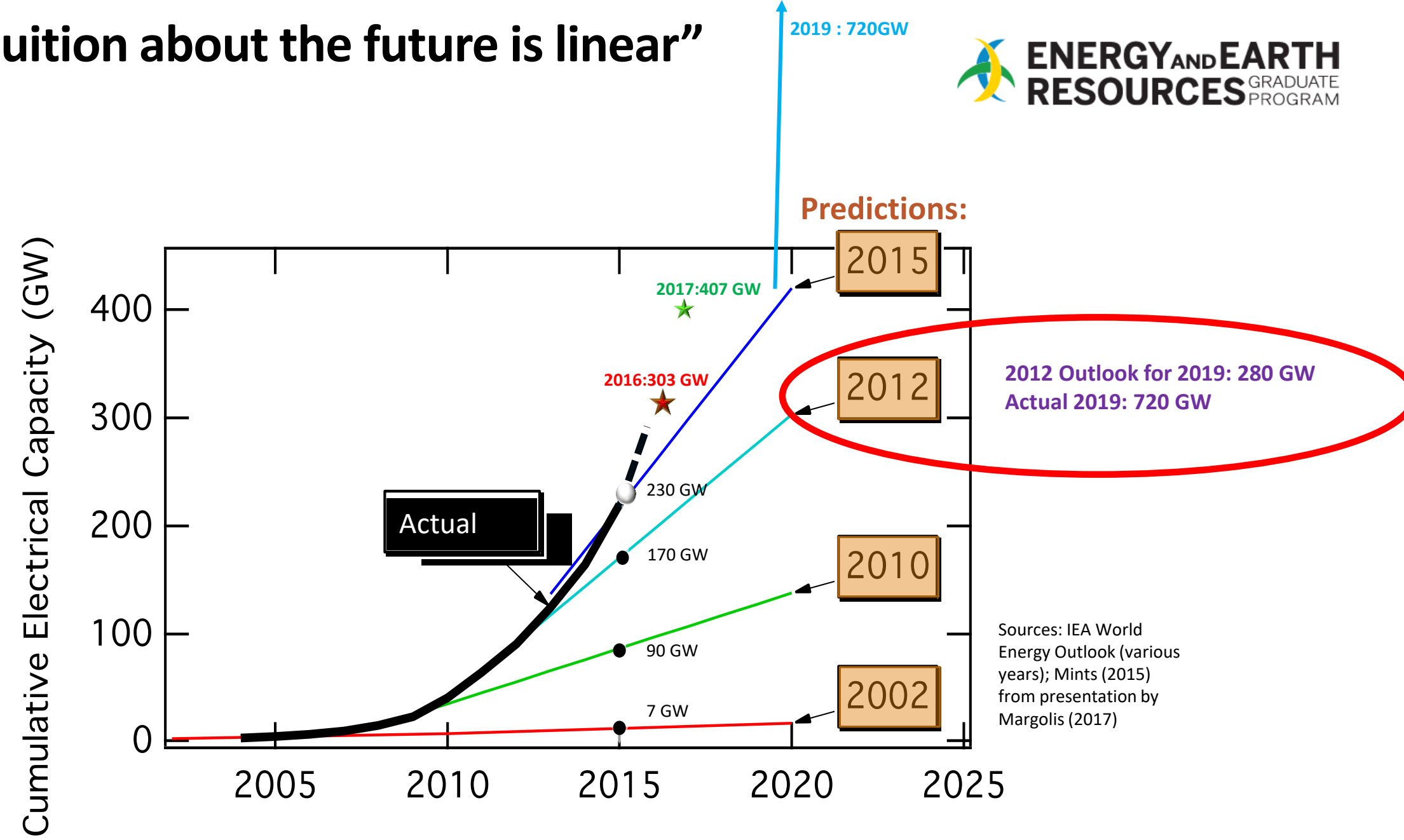
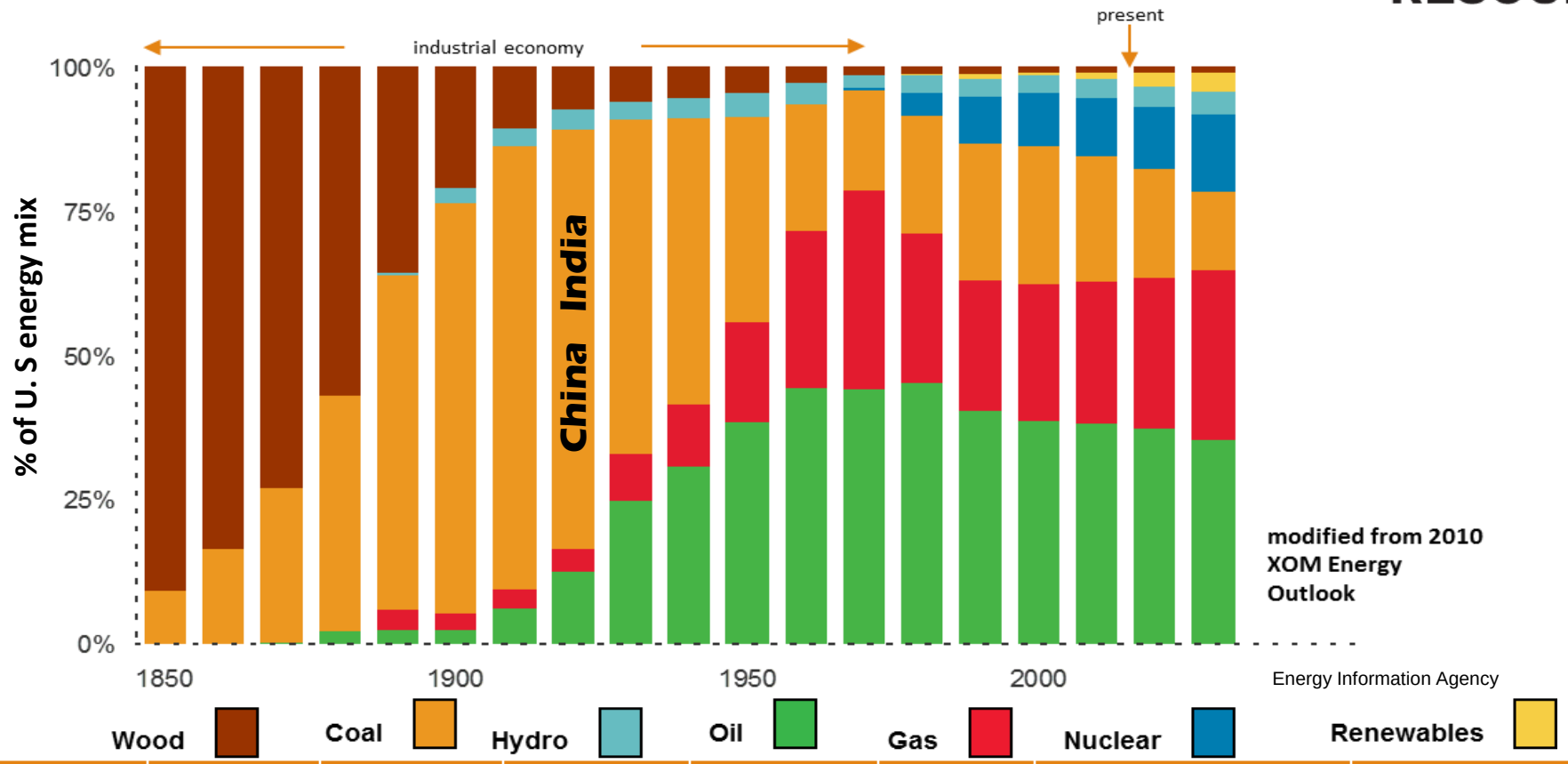


Sources: IEA World Energy Outlook (various years); Mints (2015) from presentation by Margolis (2017)

The role of the developing world



Specific energy (MJ/kg)	17	24	--	42	48	~82,000,000	--
CO2 intensity (kg CO2/kWh)	0.39	0.34	~0	0.26	0.20	~0	~0

- The energy needs of the evolving U. S. economy have been driven largely by the market
- Each energy transition has taken 40 – 50 years
- Energy is complex because problems (e.g. CO_2) are global but drivers are local (national)

The power to change

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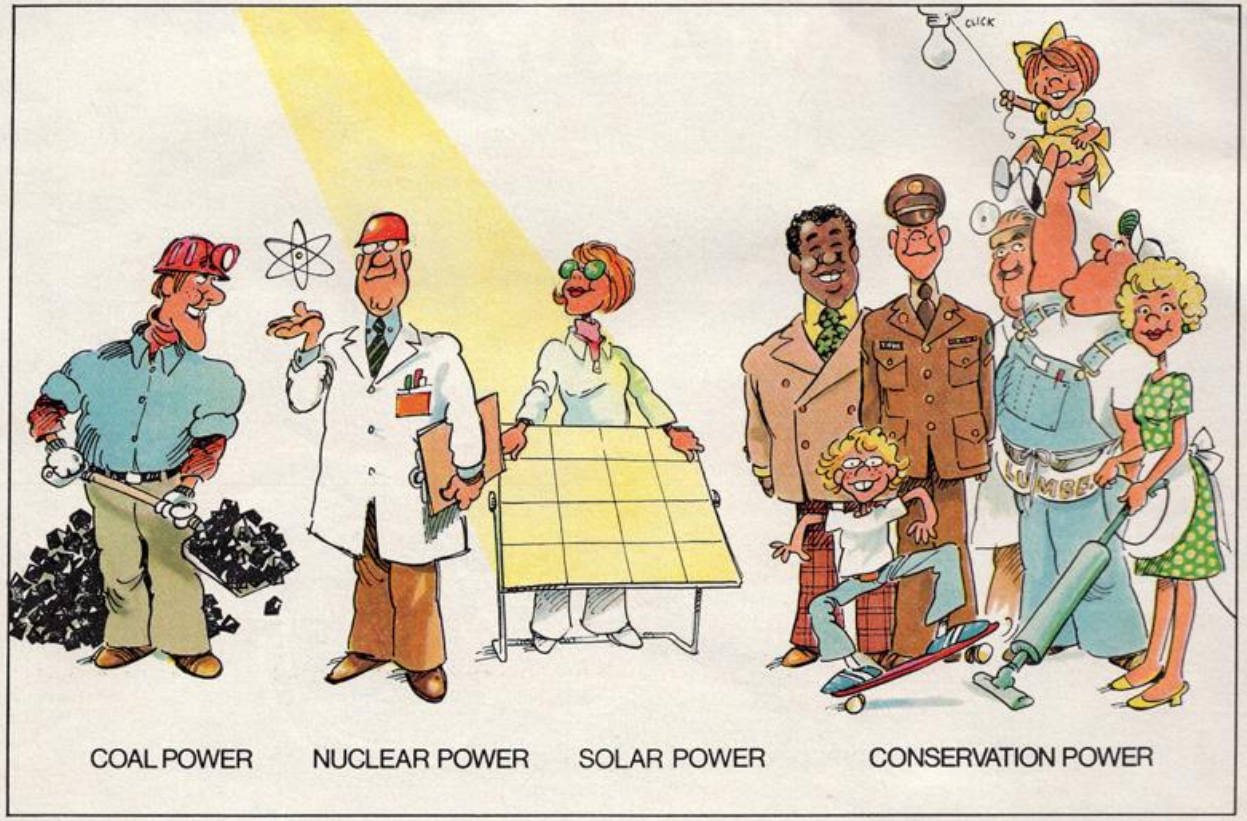
Exxon ad, 1977

The more we can put all this power to work, the easier it will be to keep us running and warm.



It'll be a while before a lot of Americans thaw out and forget the Winter of '77.

One thing it made clear was that our country has a real energy problem. Natural gas, the fuel that heats more than half of America's homes, is in short supply, and meeting demand is difficult.

And, we've got problems with our domestic oil supply. We now have to import over 40% of our oil needs. In three years, this figure is expected to reach 50%.

What's going to ease the situation? A combination of things.

We've got to find and develop more domestic oil and gas. That's top priority. But, we've also got to get busy expanding and developing other sources of energy.

America has more coal than any other country in the free world. It's a logical candidate to help ease the burden carried by oil and gas. Nuclear energy can be a big help, too. And solar power can make a contribution.

And while we're developing all of these, we can't overlook another source of energy that's readily available to us—our conservation efforts. The National Petroleum Council has estimated that American families could save 14% of the energy used in their homes. Over the course of a year, that would save as much oil as our country imports in one month.

And that's a lot of energy for a strong America.

EXXON

Energy for a strong America

- **Exxon funded and undertook ground-breaking research in solar PV (see the story of Elliott Berman and Solar Power Corp (early '70s))**
- **Exxon co-invented the Li-ion battery (1977)**

Where we'd like to end up

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Inform students (and their faculty) who are preparing to be the energy practitioners of the future

Ajay Mehta
GM New Energies Research and Technology
Shell

Raiford Smith
Director of Supply Planning Analytics, Energy, and Water
Google

Jeff Makarewicz
Group Vice President and Executive Advisor
Toyota Motor North America