
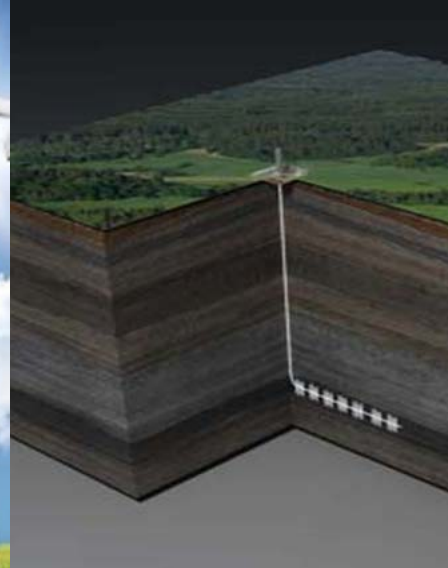


The Global Role of Natural Gas in a Climate Strategy Perspective

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MIT JOINT PROGRAM SCIENCE POLICY GLOBAL CHANGE

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Trondheim, Norway
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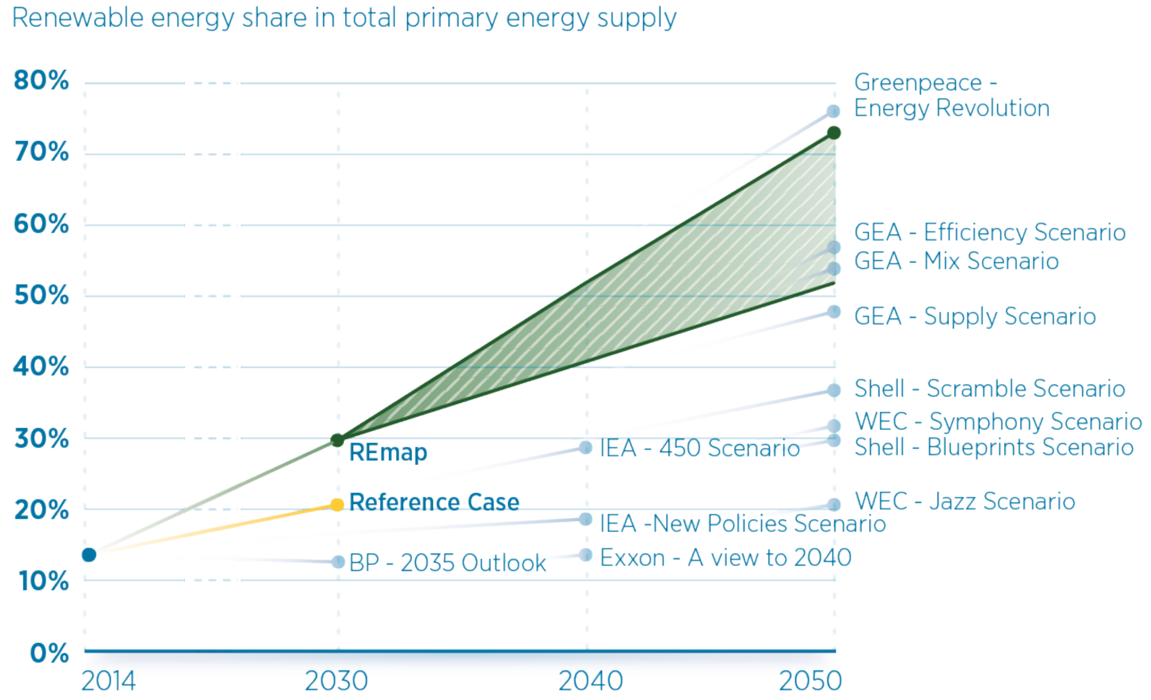
“Apples to Oranges”: Sometimes comparisons are between “best guesses”, aspirational goals, and “what if” scenarios…

Example: International Renewable Energy Agency - IRENA (2016)

FIGURE 19 Renewable energy share in total primary energy supply based on REmap and various energy scenarios, 2014-2050



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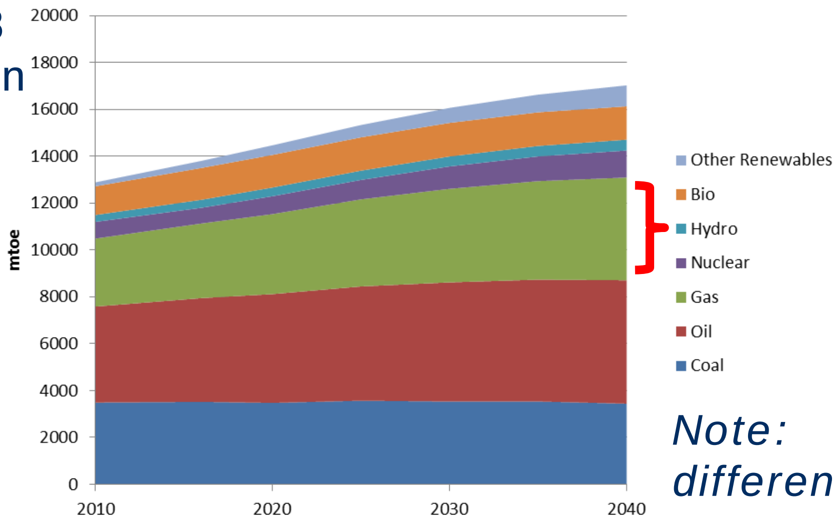
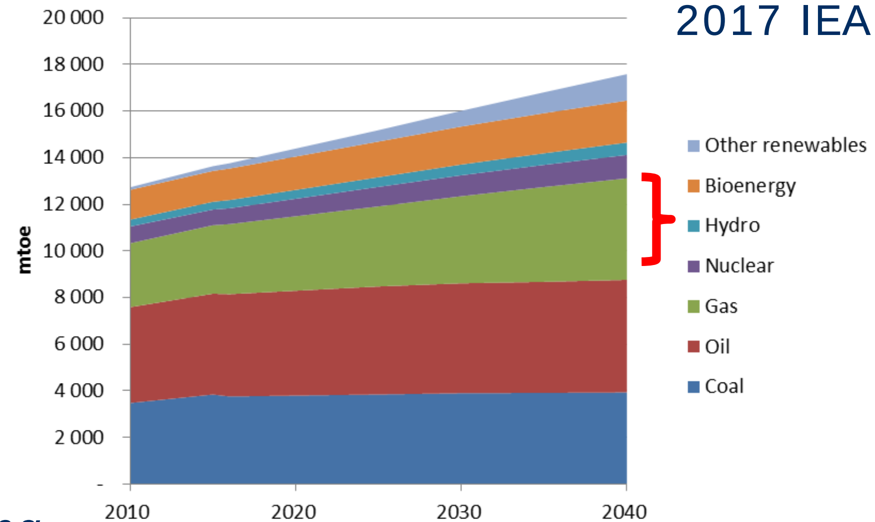
"Best guesses" – ExxonMobil, BP, "New Policies" – IEA, "Outlook" (draft) – MIT Joint Program

2018 Exxon

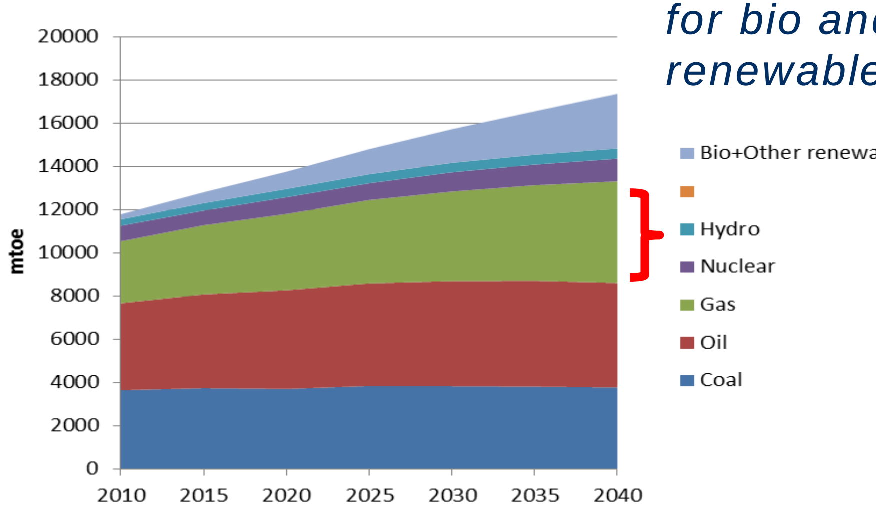


2017 IEA

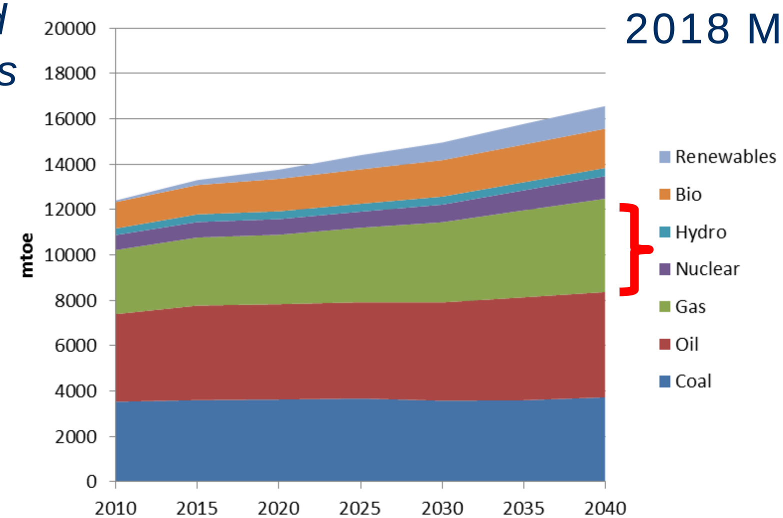


Note: different accounting for bio and renewables

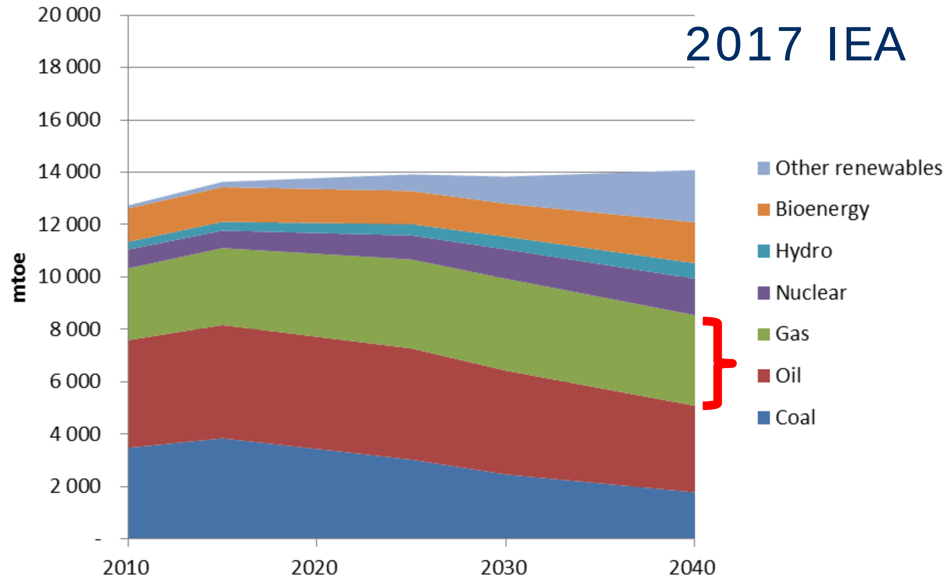
2018 BP

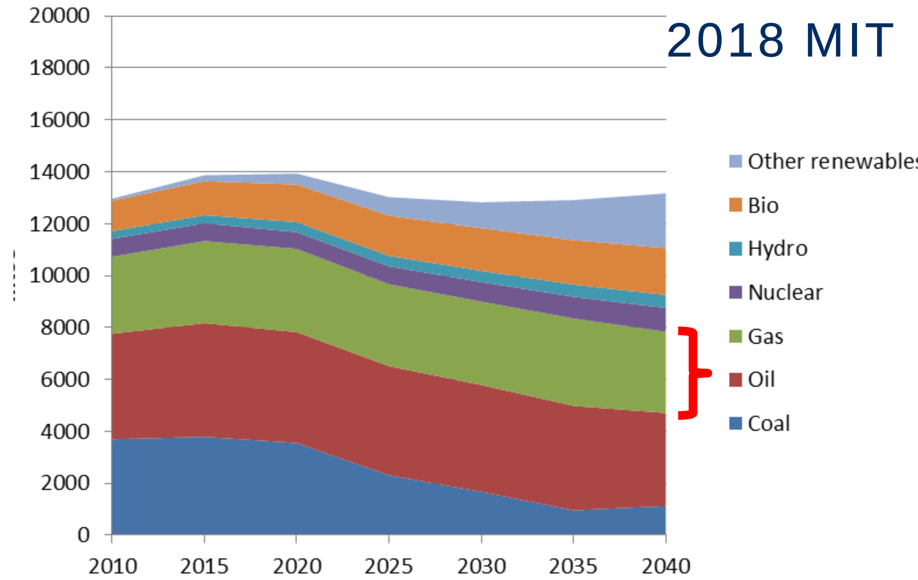


2018 MIT



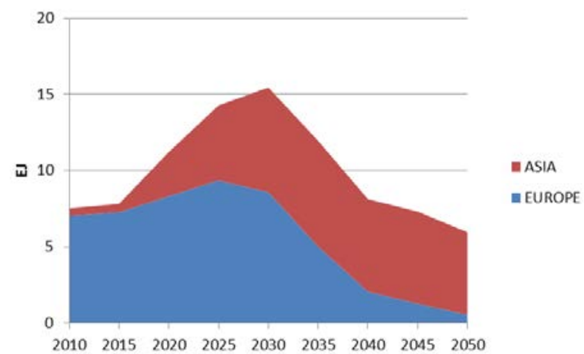
“SDS” – IEA, “2C” (draft) – MIT Joint Program





Global Natural Gas Use

mtoe	2015	2040	2040_2C
IEA	2938	4356	3458
BP	3089	4707	
Exxon	3183	4382	
EIA	3223	4600	
MIT	3002	4113	3131



Regional development for natural gas is different: e.g. Russian exports to Europe and Asia in 2C.
https://globalchange.mit.edu/publication/16859

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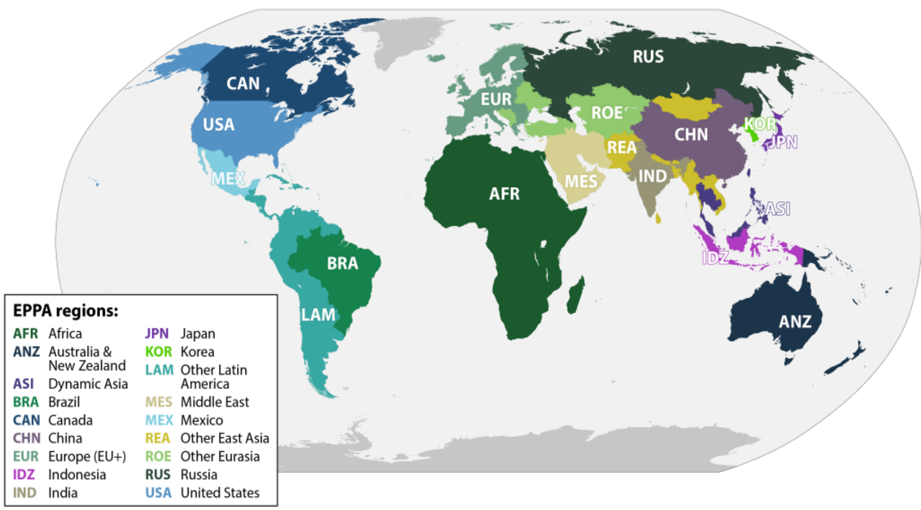
Tool for Analysis: MIT EPPA Model

Major goals:
Energy, economy, GHG and air pollutants projections.

Representation:
Global coverage,
All sectors of economy.



Non-Energy
- **Crops**
- **Livestock**
- **Forestry**
- **Food**
- **Energy Intensive Ind.**
- **Manufacturing**
- **Services**
- **Industrial Transport**
- **Household Transport**

Energy
- **Crude oil**
- **Refined oil**
- **Liquid fuel from biomass**
- **Oil Shale**
- **Coal**
- **Natural gas (conv., shale, tight, CBM)**
- **Electricity**
- **Synthetic gas (from coal)**

Vehicle Types
ICE (gasoline & diesel)
Plug-in Electric
Battery Electric

Biofuels
Current generation (Ethanol from Biodiesel)

Advanced biofuel

Technologies Included
Fossil (oil, gas, coal)
Advanced NG (NGCC)
Coal with carbon capture
Gas with carbon capture
Nuclear
Hydro
Wind and solar
Biomass

Features: Theory-based; Prices are endogenous; International Trade; Inter-industry linkages; Distortions (taxes, subsidies, etc); GDP and Welfare effects.
Trade-off: Aggregated representation of technologies.

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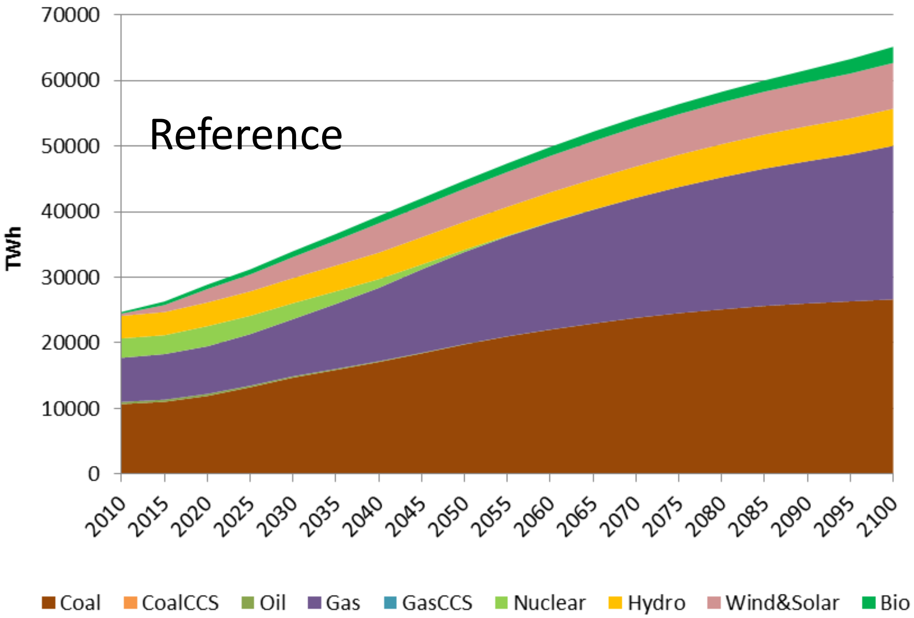
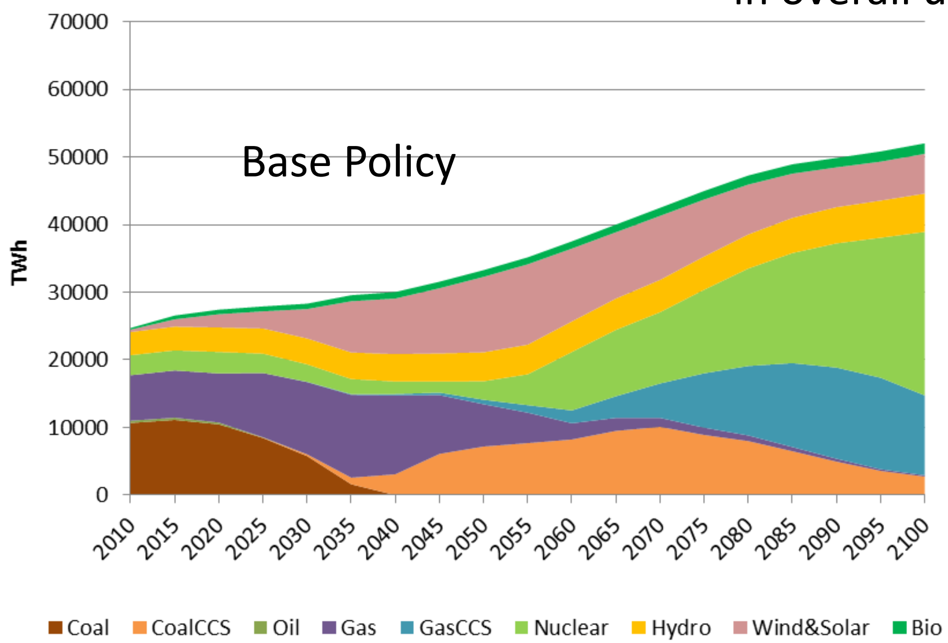
Global Power Generation: Reference vs Policy



Reference: reliance on natural gas and coal

Policy: renewables by mid-century, nuclear after 2050, coal and gas with CCS, nuclear, and a reduction in overall use



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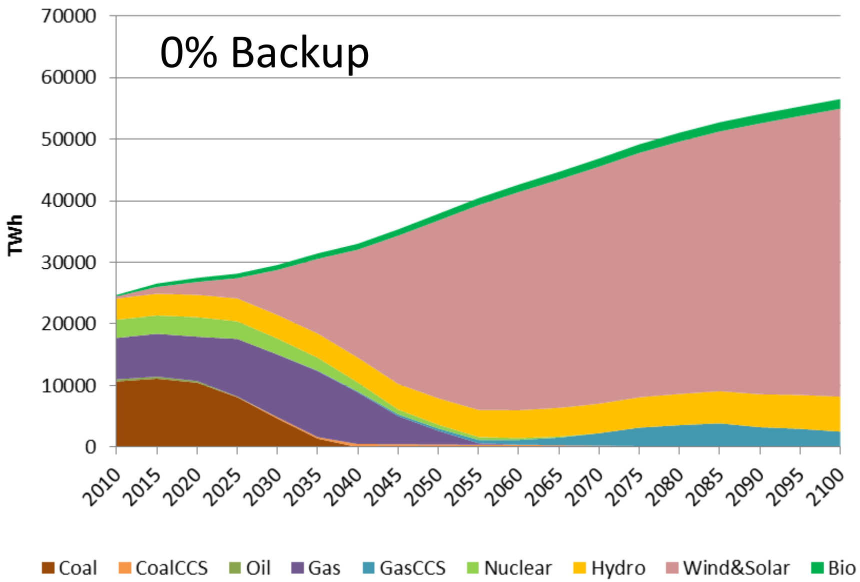
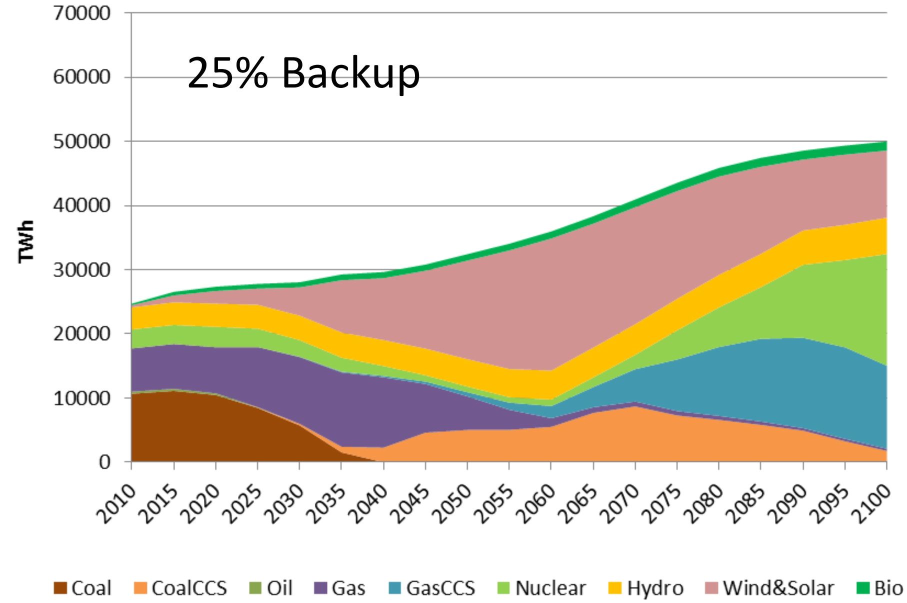
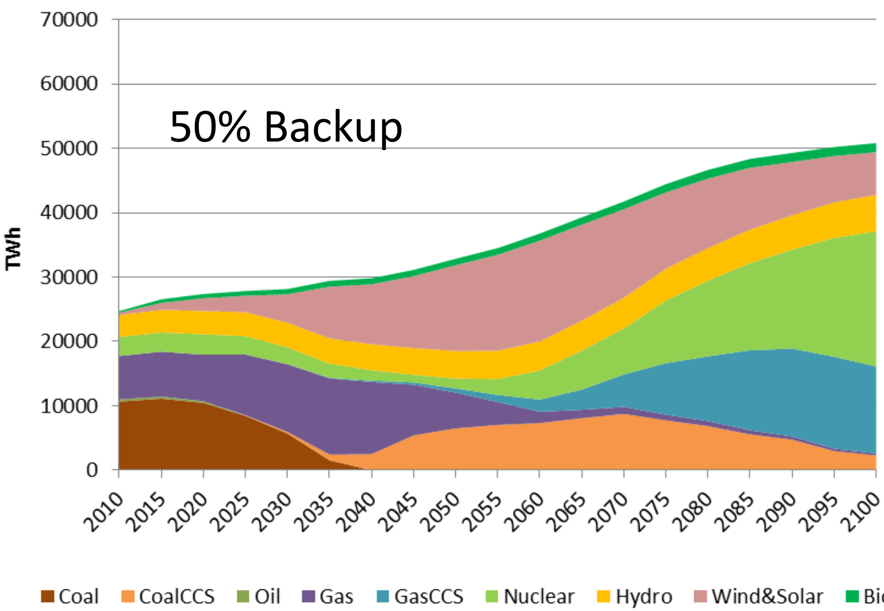
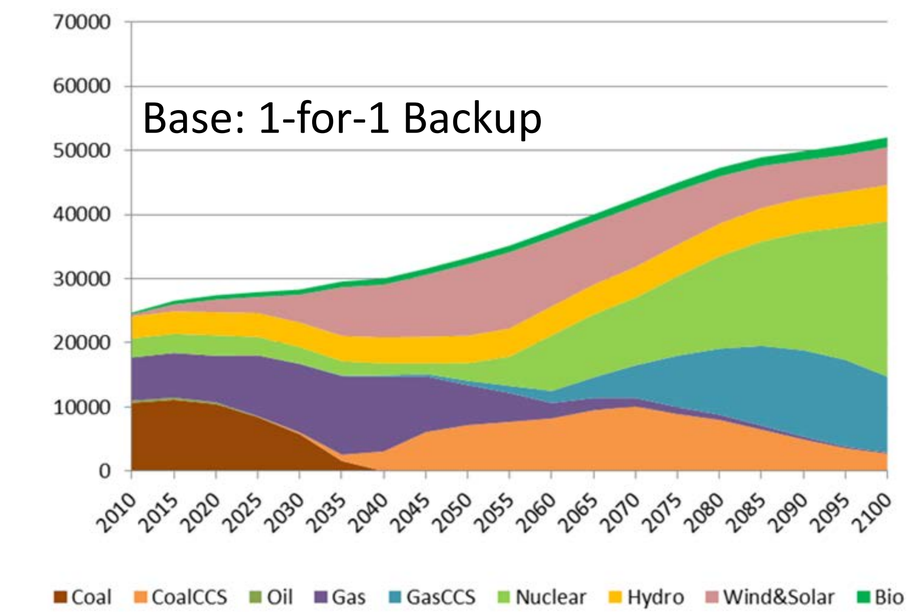
1.75C Policy: Back-Up Requirements for Renewables

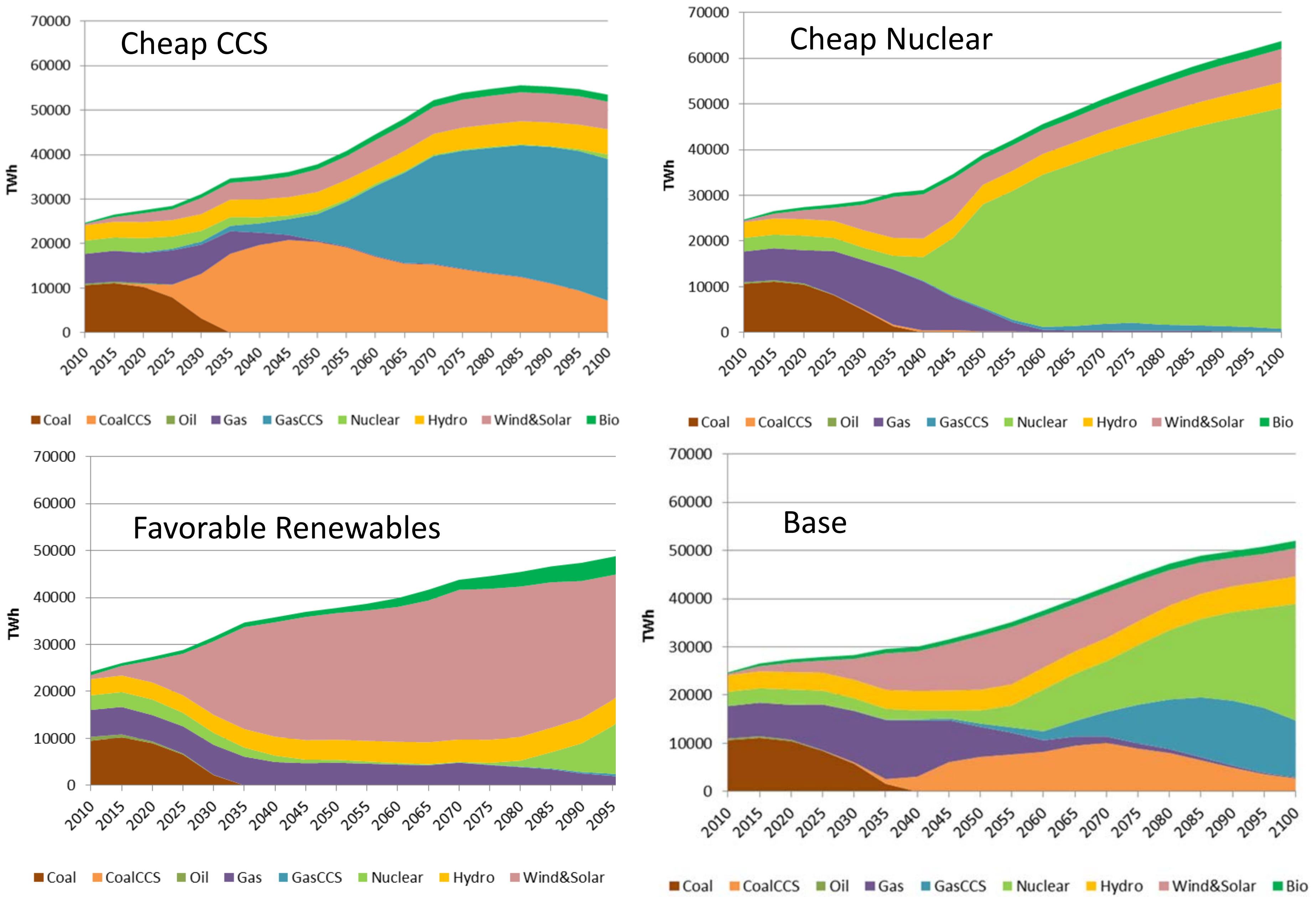








“And the winner is…”: Cheaper CCS/Nuclear/Renewables



Major Considerations

In the medium-term (up to 2040):

- Natural gas remains the major fuel. Even in the scenarios consistent with 2C.
- LNG expansion.
- Europe is the only region where natural gas production declines and consumption is flat (or decreasing in most of the 2C scenarios).
- Geopolitics of natural gas is most active in Europe (US LNG, Baltic Pipe, Nord Stream).
- Politics affects the future development (US: New England, Germany: Energiewende).

In the longer-term:

- Uncertainty. CCS is needed to extend the prospects.
- Power generation
  - Competition with Nuclear. Affected by the future developments in Renewables and Energy Storage.
  - Regional solutions are different (US – natural gas; China – nuclear and coal with CCS).
- Industrial applications with CCS.
- CHP.
- Electrification.
- Transportation (limited).

Thank you

Questions or comments?
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