



Sectoral Emission Reduction Targets and Technology Options



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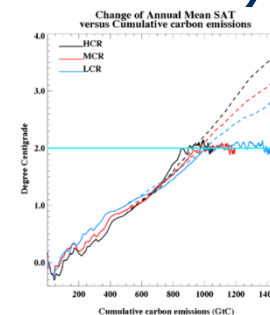
Science Based Targets

Targets for what?

- Paris Agreement - “well below 2°C”

Carbon budget for 2°C or below 2°C? (see the materials for the previous sessions of this Forum)

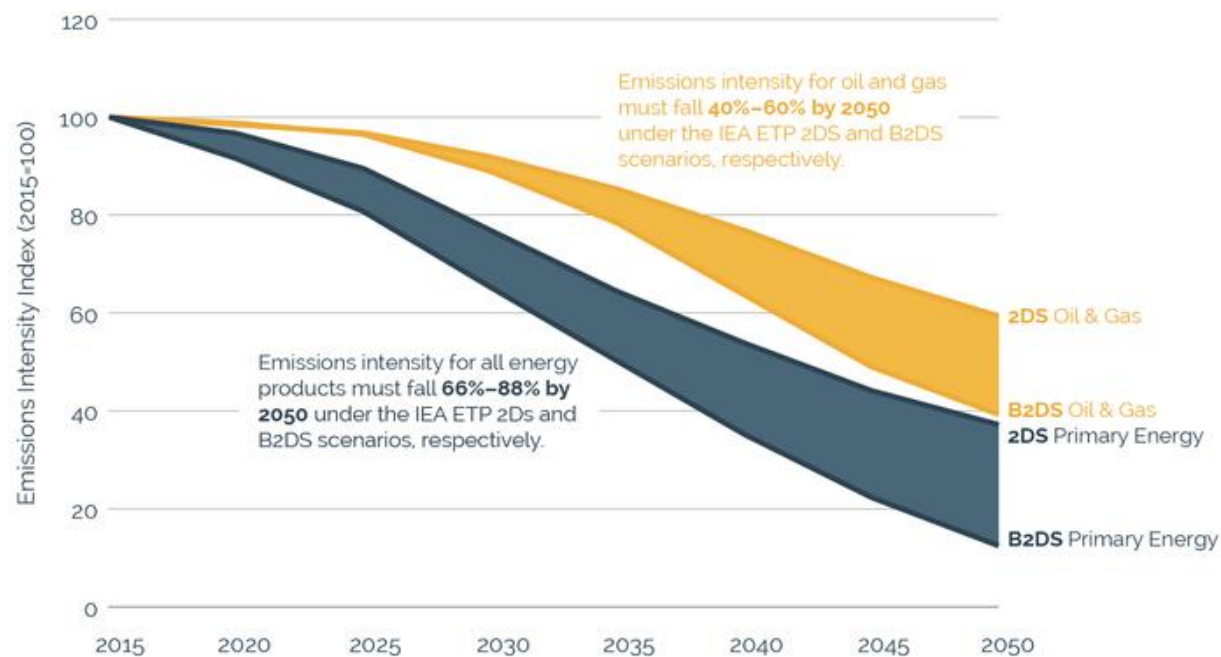
- What about non-CO₂?
- Even CO₂ – is it about 1000 GtCO₂ (IPCC, SBT), or 1550 GtCO₂ (Goodwin et al., 2018)?
- 50% probability or 66% probability? (1550 or 1450 GtCO₂)(Goodwin et al., 2018)?
- Negative emissions allowed? (then more now)
- After temperature stabilization – seemingly linear relationship between cumulative carbon emissions and temperature breaks (JP Report 309)...



Example: ScienceBasedTargets.org (WRI, WWF...)

<http://sciencebasedtargets.org/2018/02/07/how-oil-and-gas-companies-can-prepare-for-a-low-carbon-world/>

Pathways for oil and gas companies to reduce carbon intensity in line with the Paris Agreement



2DS – Pathway to limit global temperature rise to 2°C

B2DS – Pathway in line with countries' more ambitious aspirations under the Paris Agreement

Source: IEA Energy Technology Perspectives 2017



Many other organizations trace climate-related goals

Selected Examples:

Financial Implications

Task Force on Climate Disclosure (TCFD)

- climate-related financial disclosures
- scenario analysis

Investment Implications

2C Investing Initiative

- sector and technology exposure
- scenario analysis

Environmental Performance Data

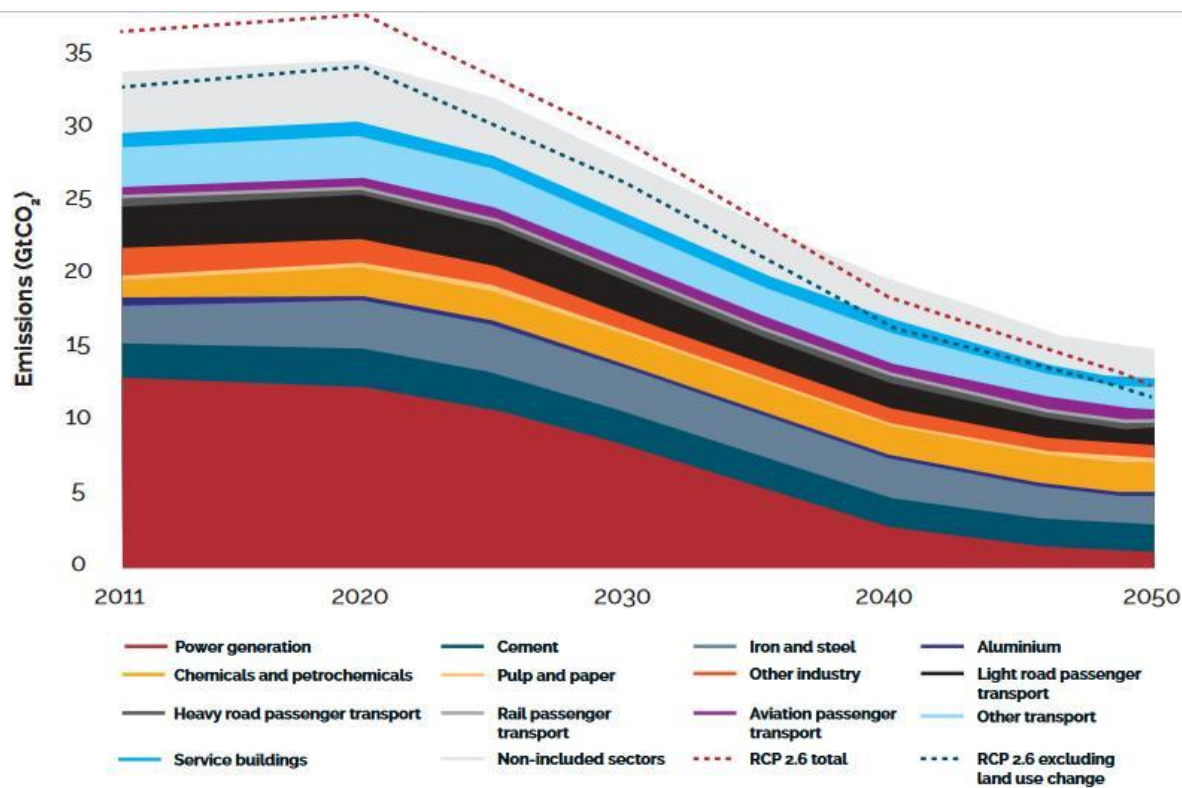
CDP (formerly Carbon Disclosure Project)

- system to report environmental data



Science Based Sectoral Targets

Most organizations use IEA WEO or IEA ETP scenarios
Only one potential future (out of many-many...)
Very aggregated scenarios (mostly CO2 only)



Source: IEA ETP 2DS 2014.

Science Based Targets Initiative | <http://sciencebasedtargets.org/>

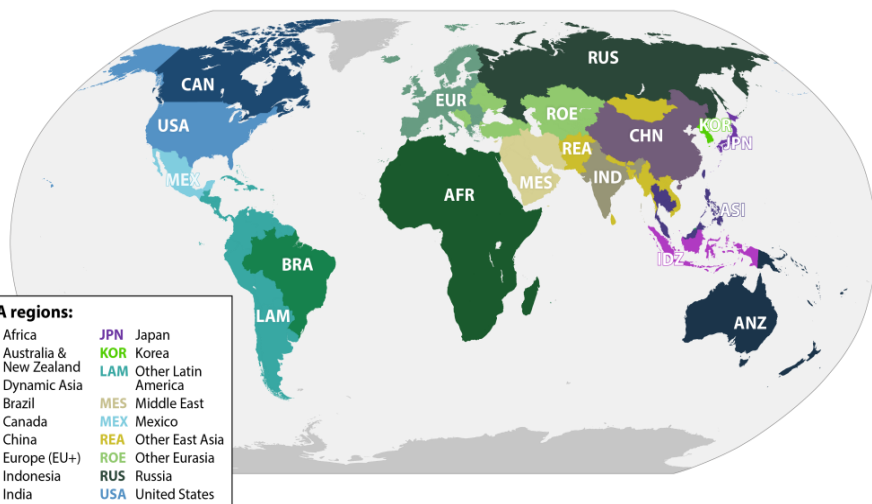


Tool for Analysis: MIT EPPA Model



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

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

Biofuels
Current generation
(Ethanol from
Biodiesel)
Advanced biofuel

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

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.



EPPA model with more disaggregated non-energy sectors

Non-Energy Sectors in disaggregated EPPA (in blue)

Crops

Rice
Wheat
Cereal Grains
Vegetables & Fruits
Oil Seeds (Soy Beans, etc.)
Sugar Cane & Beet
Plant-based Fibers (Cotton, etc.)
Other Crops

Livestock

Bovine (Cattle, Sheep, Horses, etc.)
Animal Products (Poultry, Eggs, etc.)
Other Livestock

Energy-Intensive Industries

Cement
Iron & Steel
Non-ferrous Metals (Aluminum, etc.)
Other Energy-Intensive Industries

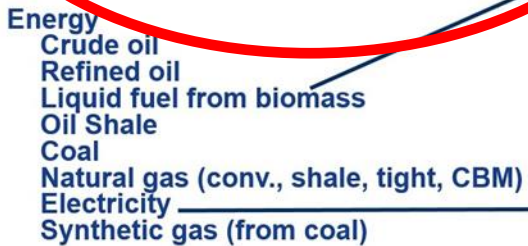
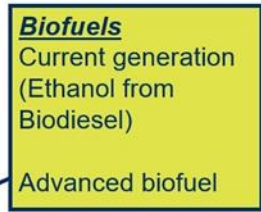
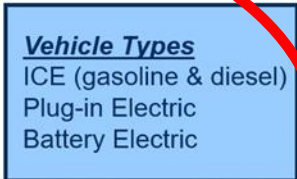
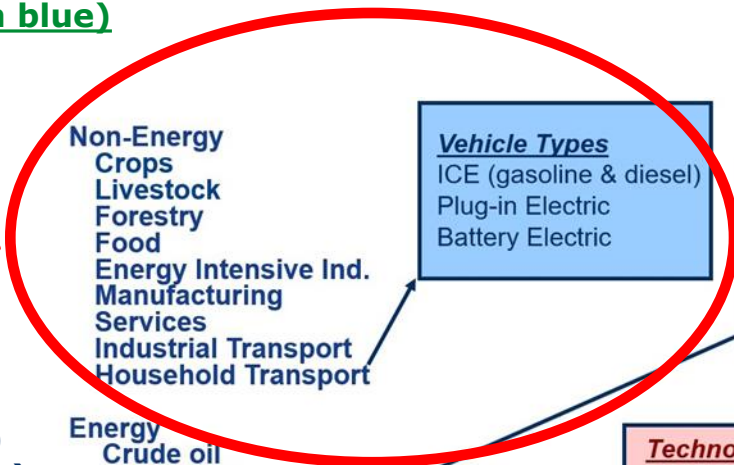
Manufacturing

Wood Products
Other Manufacturing

Services

Construction
Other Services

Forestry
Food Production
Industrial Transport
Household Transport



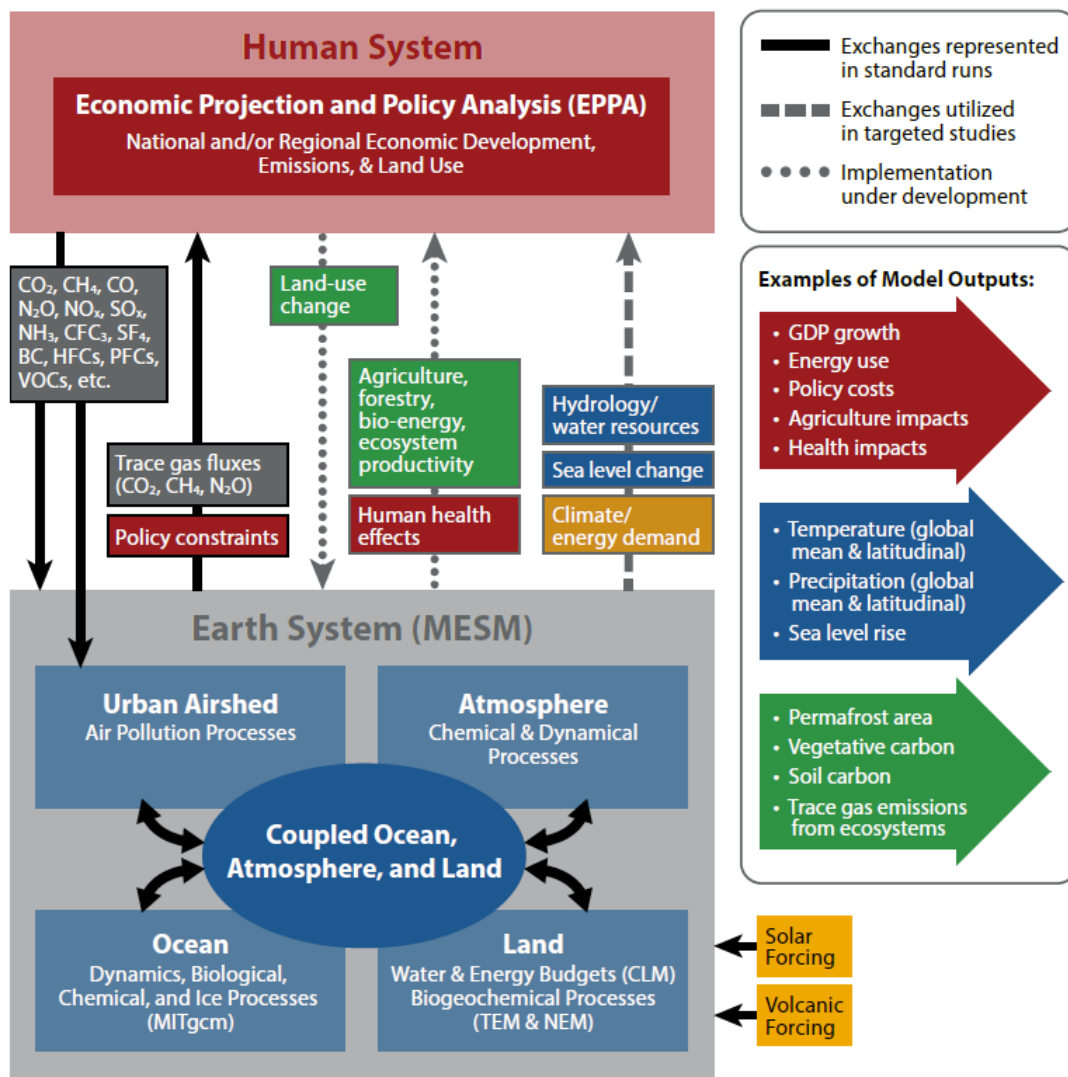
Energy sectors are the same as before (as in regular EPPA)



These sectors are the same as before (as in regular EPPA)

THE MIT INTEGRATED GLOBAL SYSTEM MODEL (IGSM)

Earth and Human System Links



2°C Scenarios

Focus on “Accelerated Paris to 2C” up to 2050:

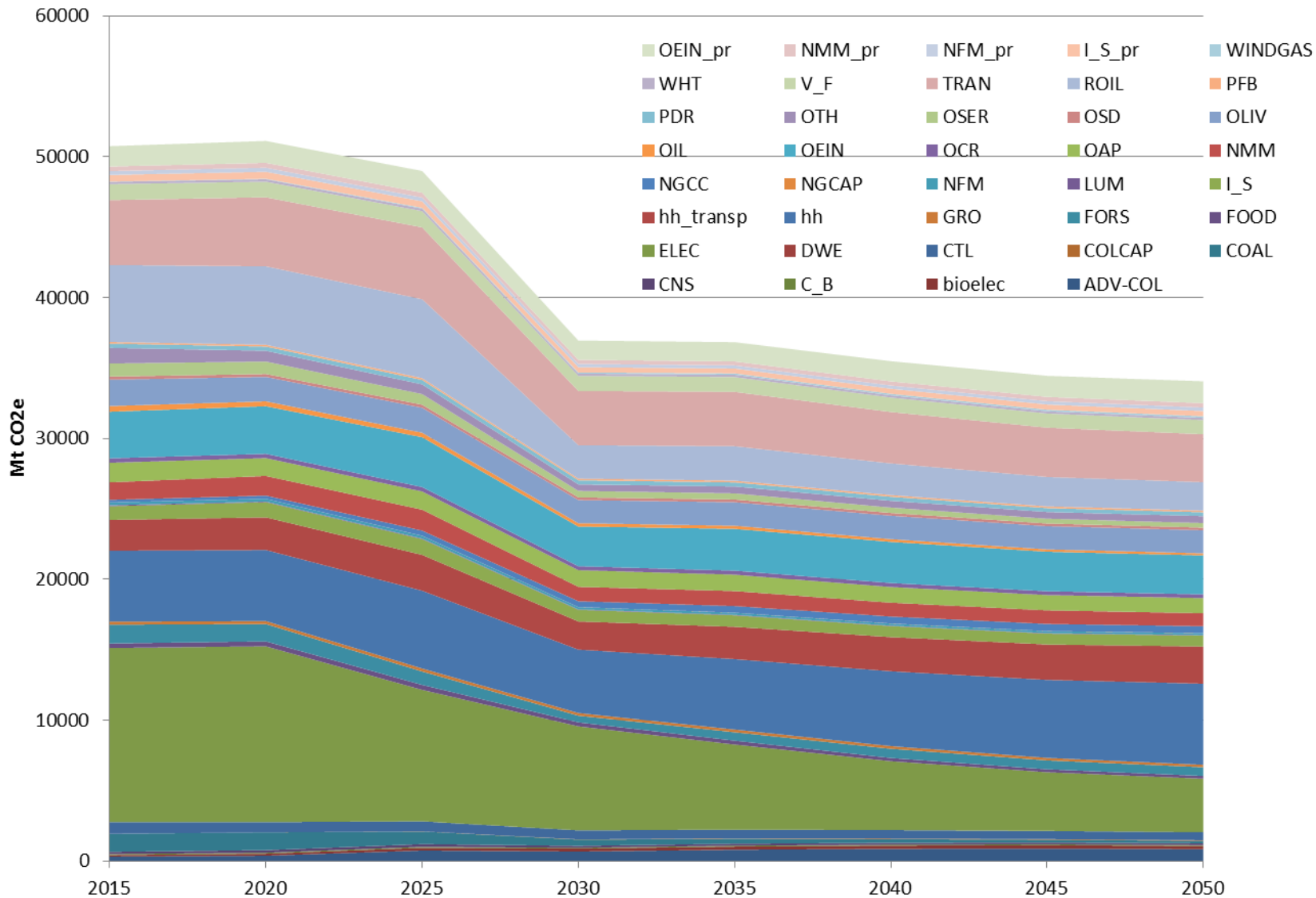
- *Paris2C*
- *Paris2C with Forest Sink*

Implemented in EPPA as LUC with exogenous and endogenous profiles for deforestation/reforestation

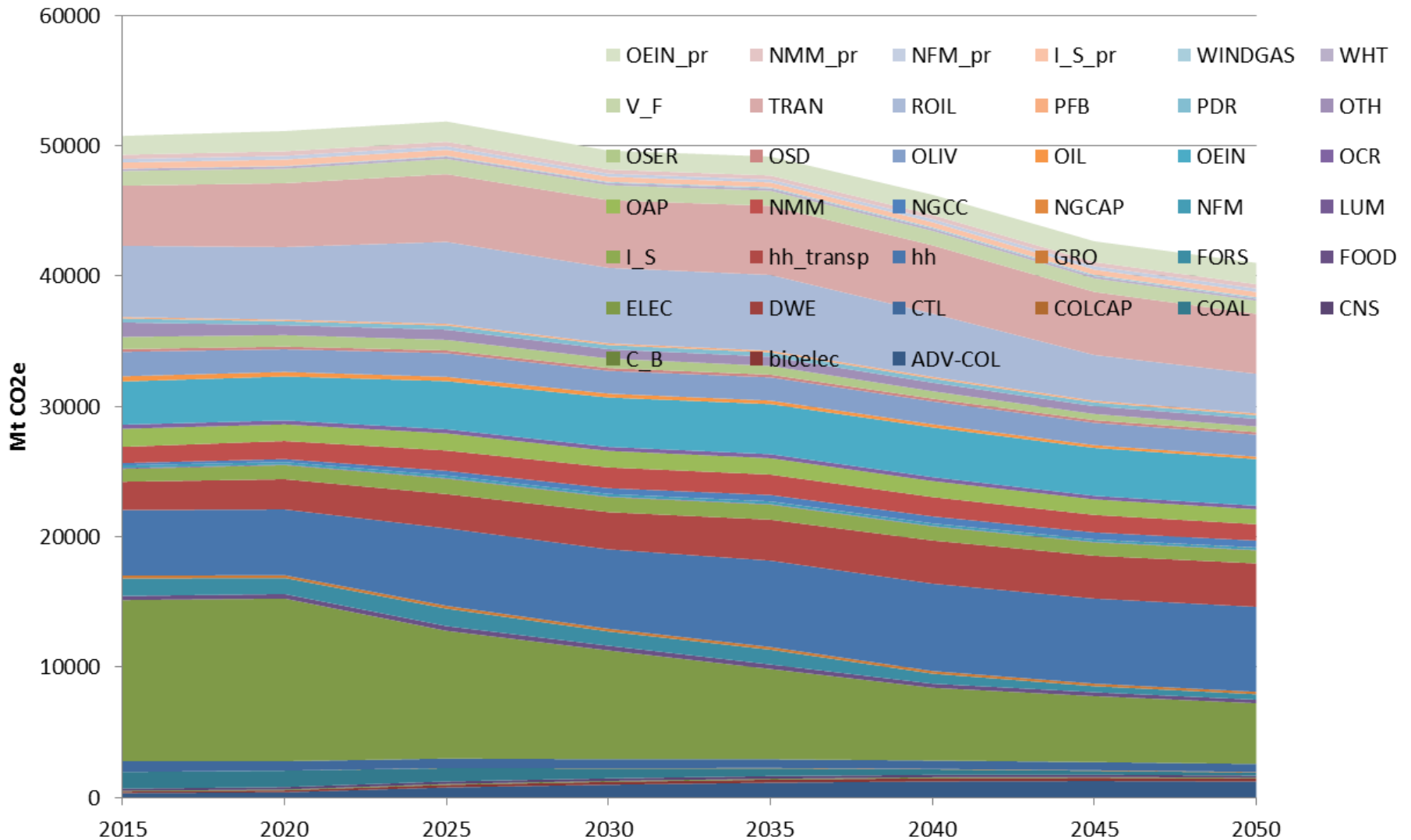
Energy+Industrial Process emissions in these scenarios are similar to two scenarios in John’s presentation in the previous session of the Forum:

- Paris to 2C;
- Paris to 2C with Forest Sink, where additional room of 210 Gt CO₂ created by forest sink is used by 2060

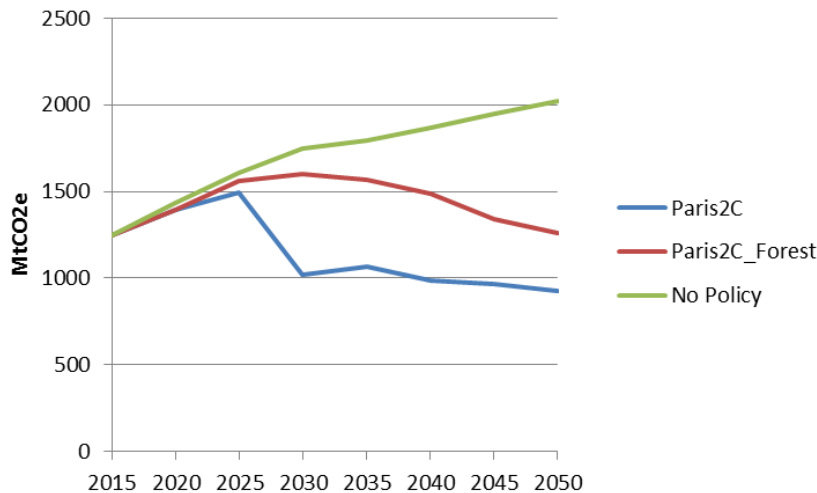
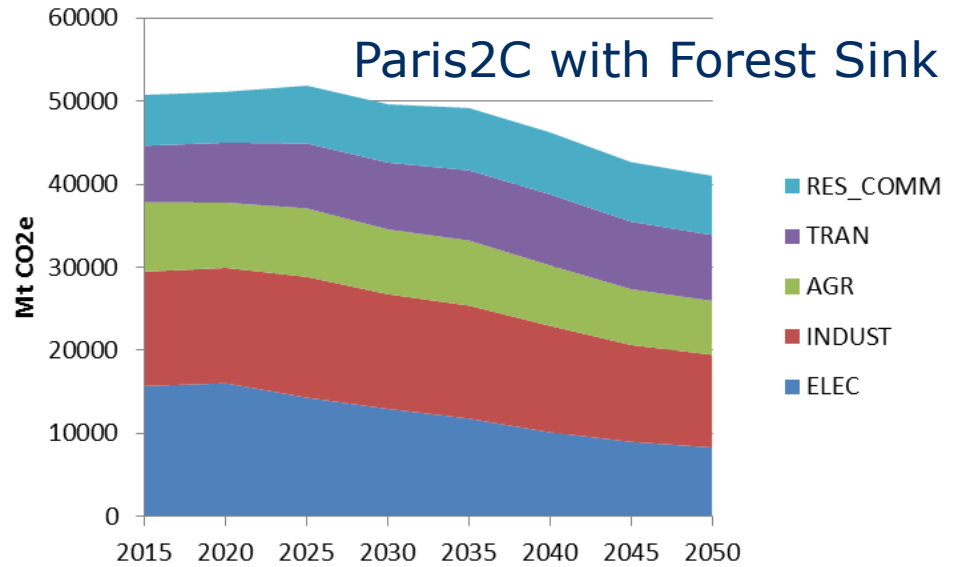
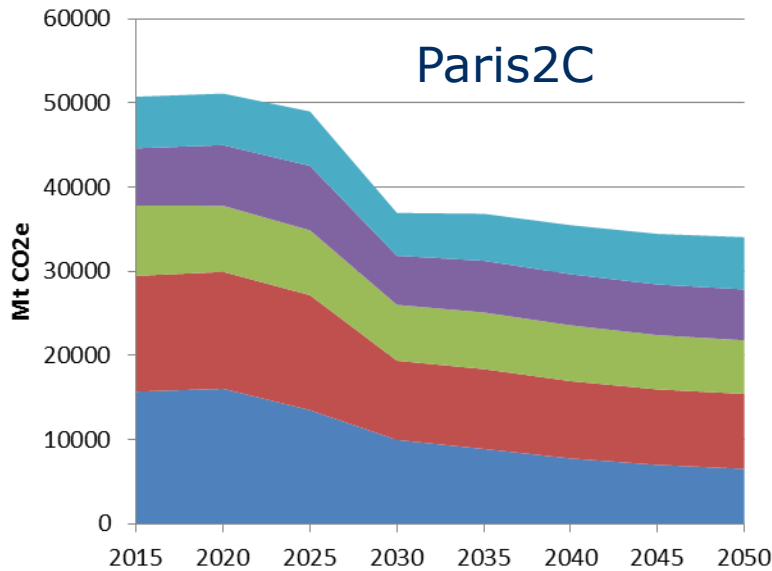
Sectoral GHG emissions in Paris2C



Sectoral GHG emissions in Paris2C with Forest Sink

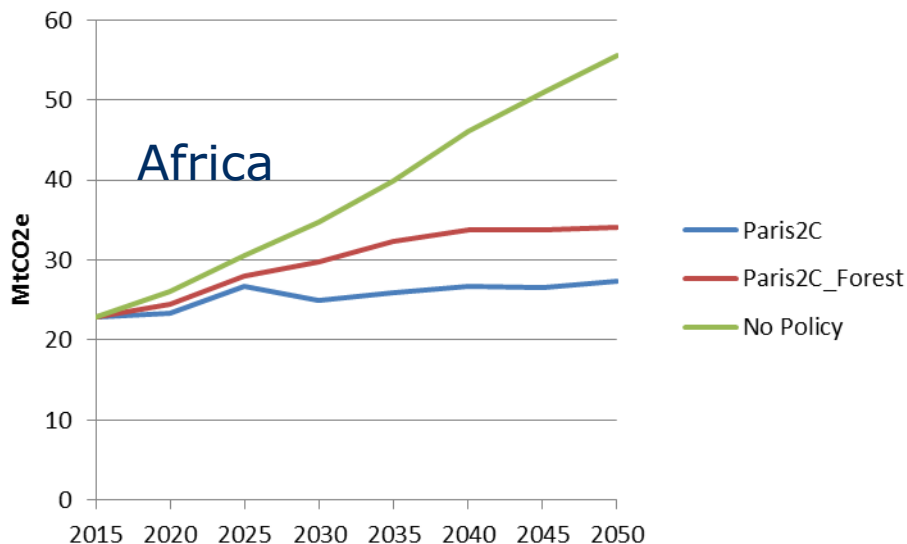
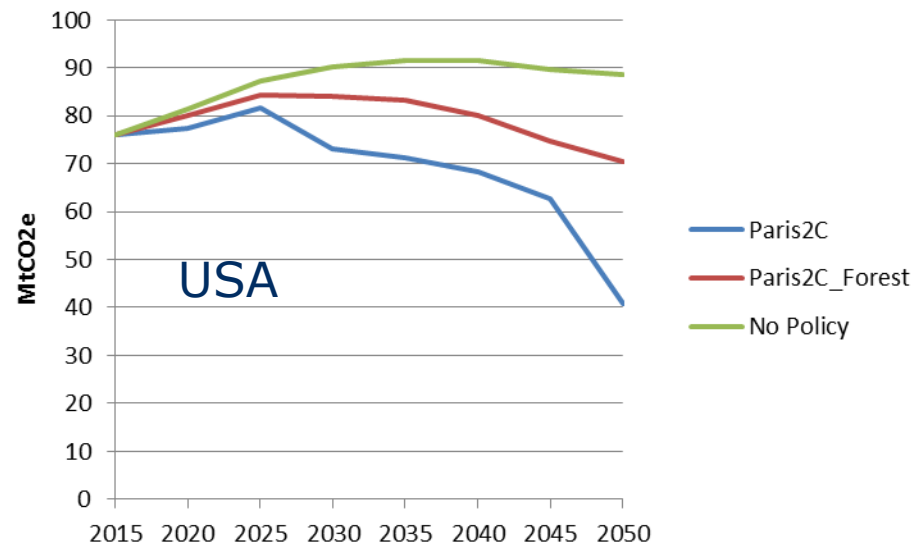
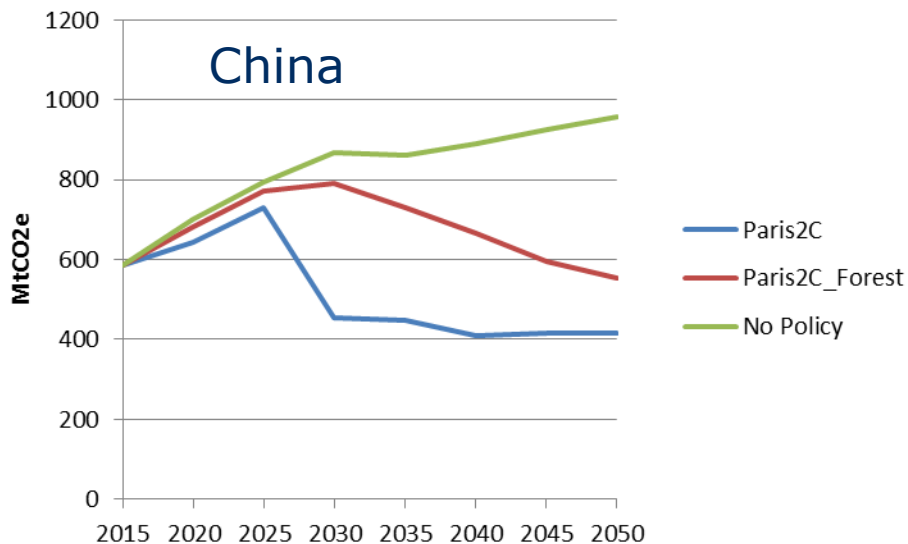


Sectoral GHG emissions consistent with 2°C (aggregated version)



Example: (Energy-related) NMM (cement) GHG emissions in 2025-2030: *30% reduction* or *3% growth* - both consistent with 2°C trajectories

Regional profiles are different...



Likely, they also would vary with different assumptions about emission trading, capital cost, etc.

Concluding remarks

Many emission profiles are consistent with the 2°C goals of the Paris Agreement.

The tool for sector specific targets – scenario analysis.

Sector specific targets vary substantially with different assumptions about policies, costs, and technologies (and available carbon budget).

Region specific targets for sectors may also vary.

One clear message: emissions should go down...

Technology Options (see the session tomorrow morning):

- Low-carbon (wind, solar, nuclear, CCS, hydrogen, fusion)

- Reforestation

- Electrification

- Efficiency, digitalization...

Thank you

Questions or comments?

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