



MODELLING THE GLOBAL ECONOMIC IMPACTS OF ENERGY EFFICIENCY

LESSONS FROM THE IEA *EFFICIENT WORLD SCENARIO*

(Preliminary analysis: not to be cited or quoted)

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The OECD general equilibrium framework

- ✓ **Analysis of the global economics implications of enhanced energy efficiency policies measures hinging on economically viable technologies only.**
- ✓ **Draws upon IEA Efficient World Scenario (WEO, 2012).**
- ✓ **Original linking of Bottom-Up to Top-Down models (resp. IEA Word Energy Model & OECD ENV-Linkages).**
 - Consistent set of results across models
 - Energy and economic details at the sectoral and country level



The OECD ENV-Linkages model (version used here)

- ✓ Computable General Equilibrium (CGE) model
 - Simultaneous equilibrium on all markets
 - Structural trends, no business cycle
 - International trade
 - 27 Economic Sectors – 15 Regions
- ✓ Recursive-dynamic: horizon 2005-2035; vintages of capital
- ✓ Main drivers
 - Primary factor supply, relative price changes, factor productivity, energy efficiency improvement



Calibration Step 1: Current Policies Scenario

Input data from WEO(2012)

- i. Projection of intermediate demands for energy carriers (refined oil, coal, gas and electricity) by firms for each sector and country.
- ii. Projection of final demands for energy carriers by households
- iii. Projections of country-based fossil fuel supply
- iv. GDP assumptions expressed in real 2011US\$
- v. Detailed electricity generation mix (fossil fuels, nuclear, hydro, solar & wind as well as other renewable combustibles)
- vi. Carbon prices and fossil-fuel subsidies (2011) by sector and country

Logically in a CGE model all these demands, GDP, electricity supply by technology are endogenous variables while exogenous variables are households preferences, production structures, primary factor supply, technical progress, human capital, energy efficiency improvements (AEEI).

To calibrate the OECD model to WEO model we choose to invert some variables are parameters to match the CPS features (i.)-(vi.).

Exple 1.: AEEI to reproduce given intermediate demands for energy

Exple 2: Average human capital growth to reproduce given GDP,...



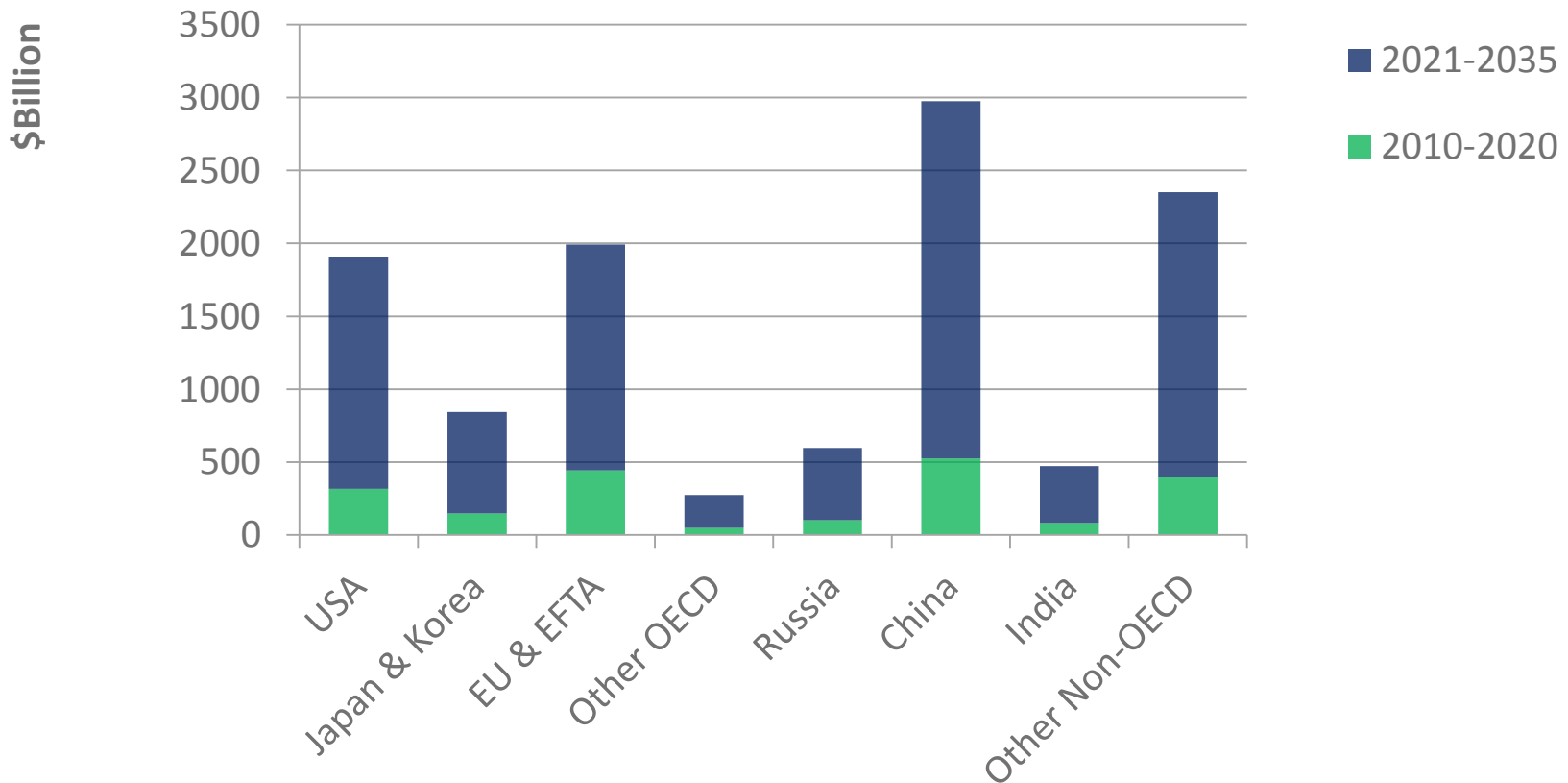
Calibration Step 2: Implementation of the New Policies and Efficient World Scenarios

- ✓ **Additional energy policies** to the Current Policies Scenario
 - ⇒ A reform of fossil fuel subsidies in energy producing countries (only Russia and Middle-East on top of NPS assumptions)
 - ⇒ Sectoral carbon prices in some countries
 - ⇒ Other regulatory instruments (e.g. fuel economy standards)
 - ⇒ All side-effects factored in – direct and indirect (e.g. rebound in energy demand stemming from lower energy prices)

- ✓ **Additional investments** relative to the Current Policies Scenario needed to reach targets in the New Policies or Efficient World Scenario
 - ⇒ Increase of capital stock by sector (capital cost driven)
 - ⇒ Overall capital inflow of \$11.8 trillion over 2012-2035 (derived by IEA)
 - ⇒ Increase Energy Efficiency such as to reproduce some of the NPS and EWS Energy demands



Additional investments in end-use energy efficiency by country in the Efficient World Scenario



Source: IEA (2012)



Key channels in the Efficient World Scenario by sector

Effects of additional dedicated investments

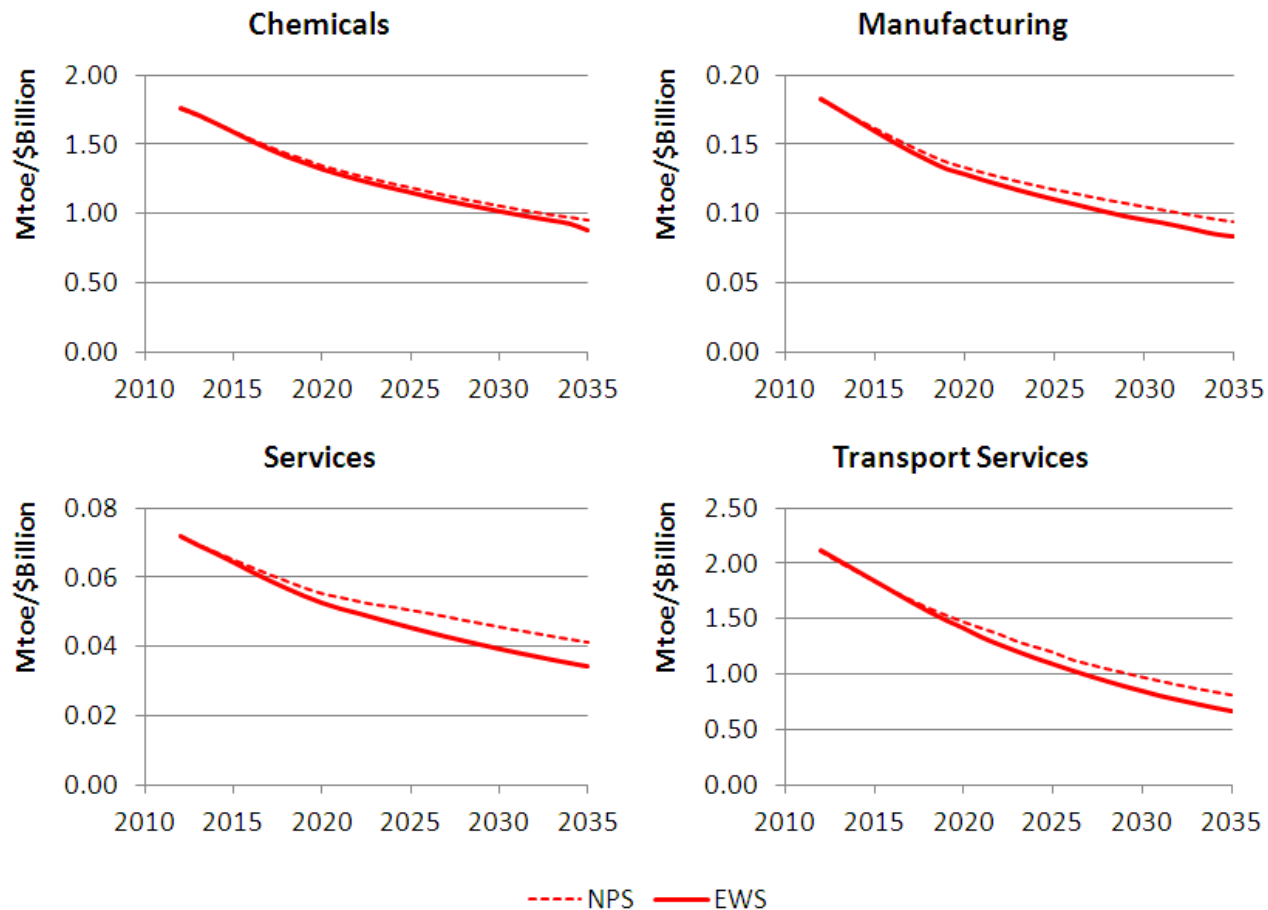
Two key policy-driven effects:

1. Extra investments result in **additional capital stock** in addition to a reduced energy bill for some activities
 - ⇒ Capital-energy substitution
 - ⇒ Reduction of production costs in capital intensive industries
2. Extra investments imply additional final demand for some specific goods or services to build extra capital
 - Transport or Services: Effects 1 & 2
 - Chemicals: Effect 1 only
 - Construction: Effect 2 only (+ Cement through Construction)
 - Energy industries: Effect 2 but negative

+ Additional CGE Effects: terms of trade changes, sectoral reallocation through price changes, keynesian-multiplier through savings changes, ...



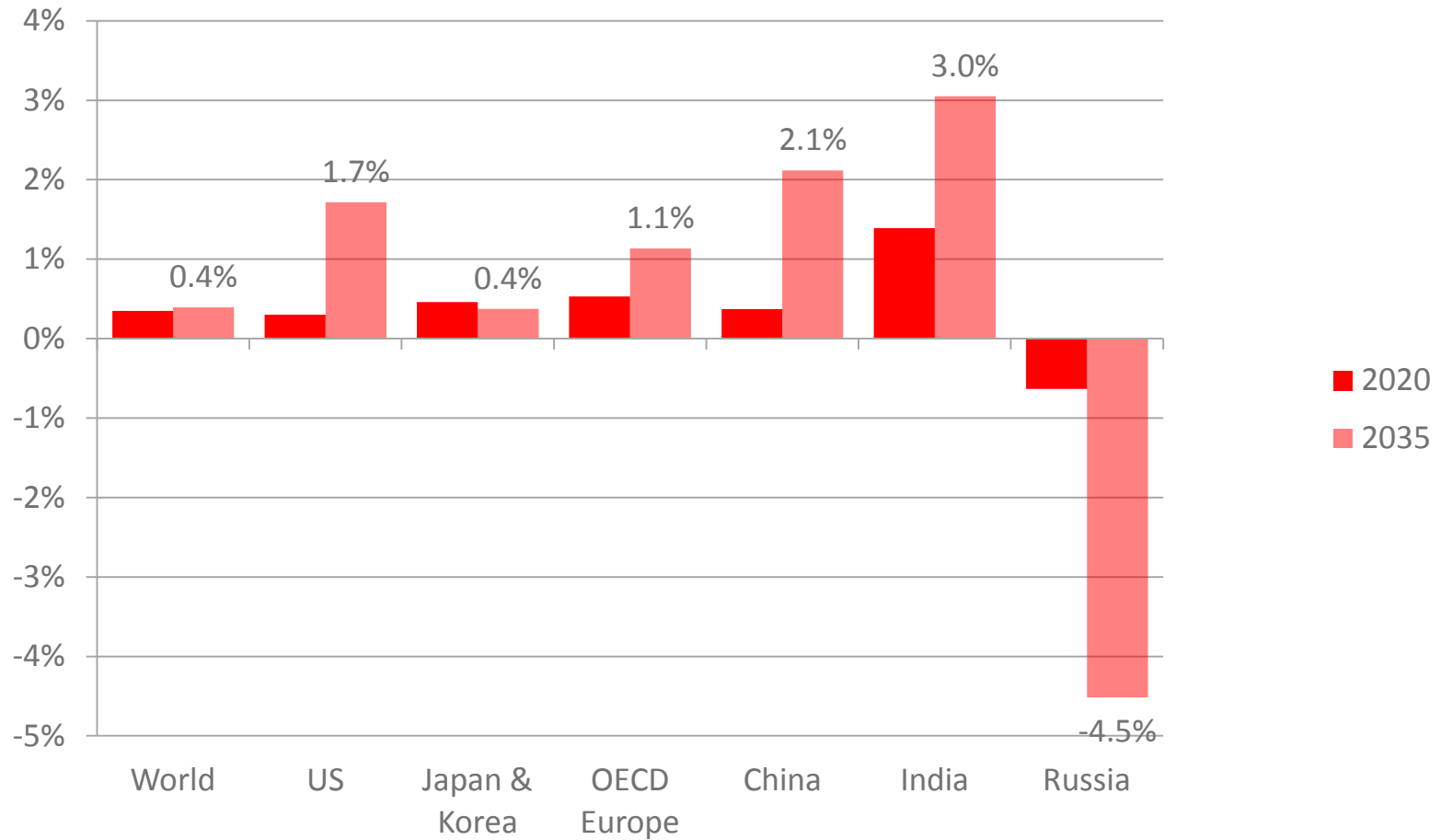
Global energy-capital ratio in New Policies and Efficient World Scenarios for some production sectors





% GDP Deviation in 2035

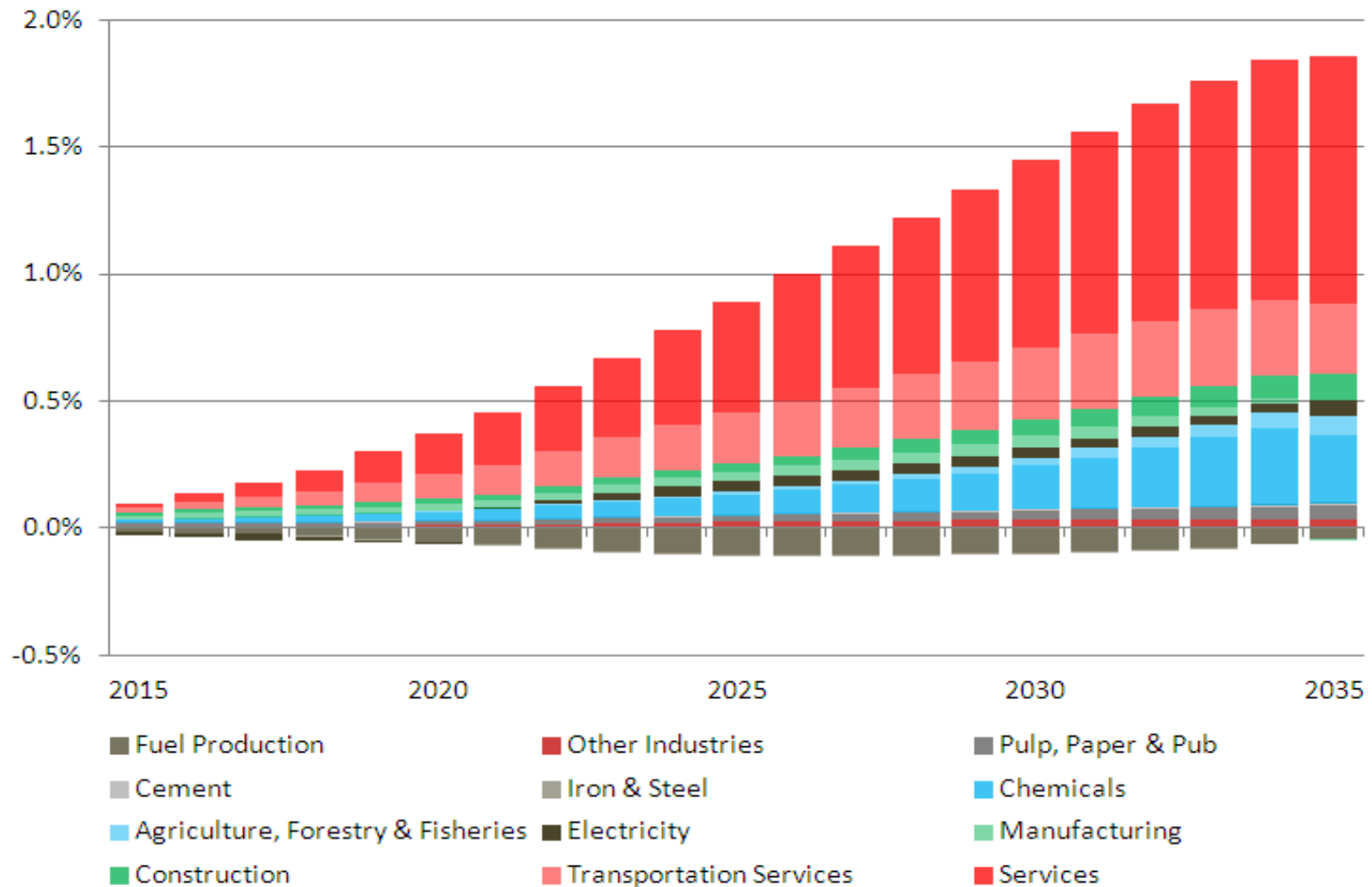
Efficient World Scenario relative to the New Policies Scenario





%Change in sectoral real value added - United States

Efficient World Scenario relative to the New Policies Scenario

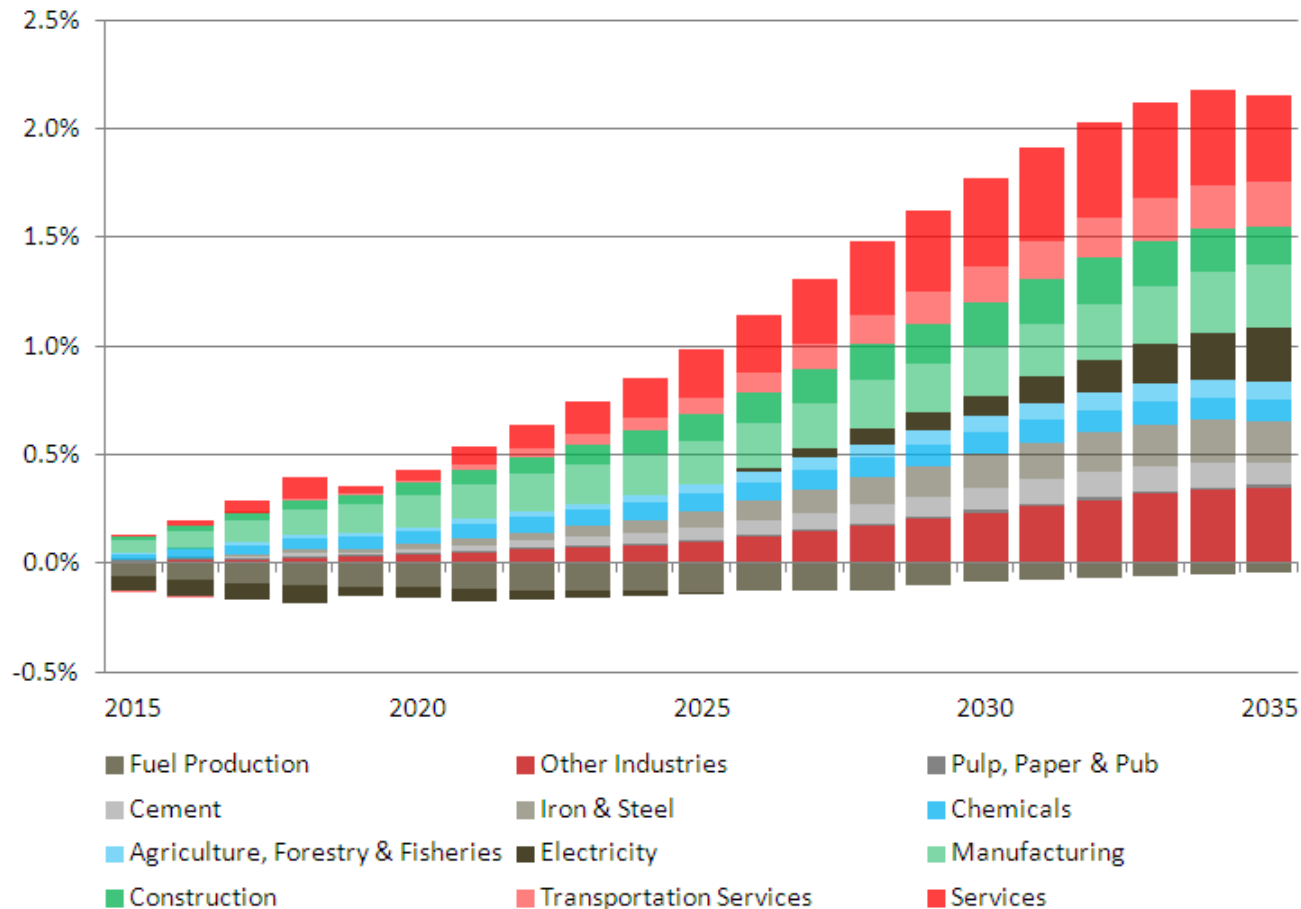


Note: Value-added measured at basic prices



%Change in sectoral real value added - China

Efficient World Scenario relative to the New Policies Scenario

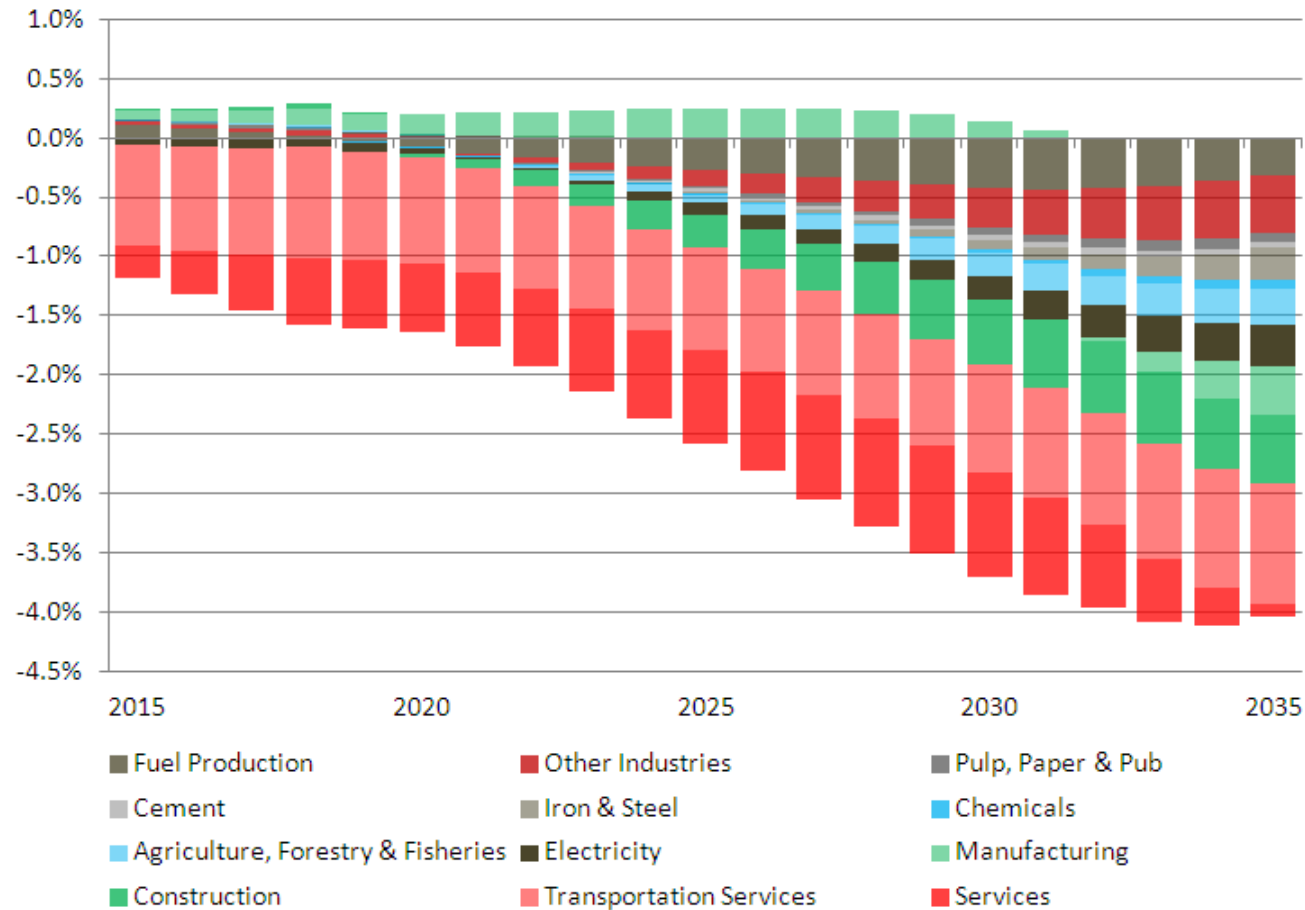


Note: Value-added measured at basic prices



%Change in sectoral real value added - Russia

Efficient World Scenario relative to the New Policies Scenario



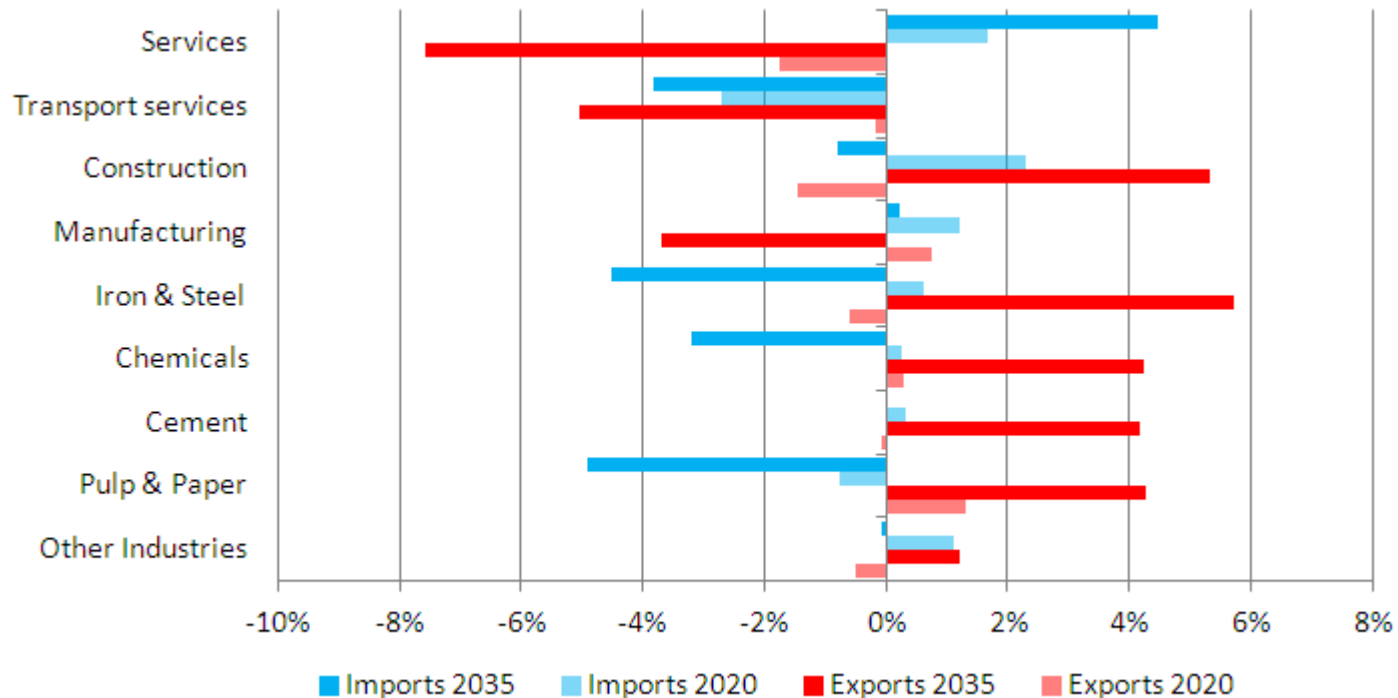
Note: Value-added measured at basic prices

The reduction in global demand for fossil fuels more than offsets the economic benefits of improving efficiency (notably in the power sector)



%Change in sectoral trade - United States

Efficient World Scenario relative to the New Policies Scenario



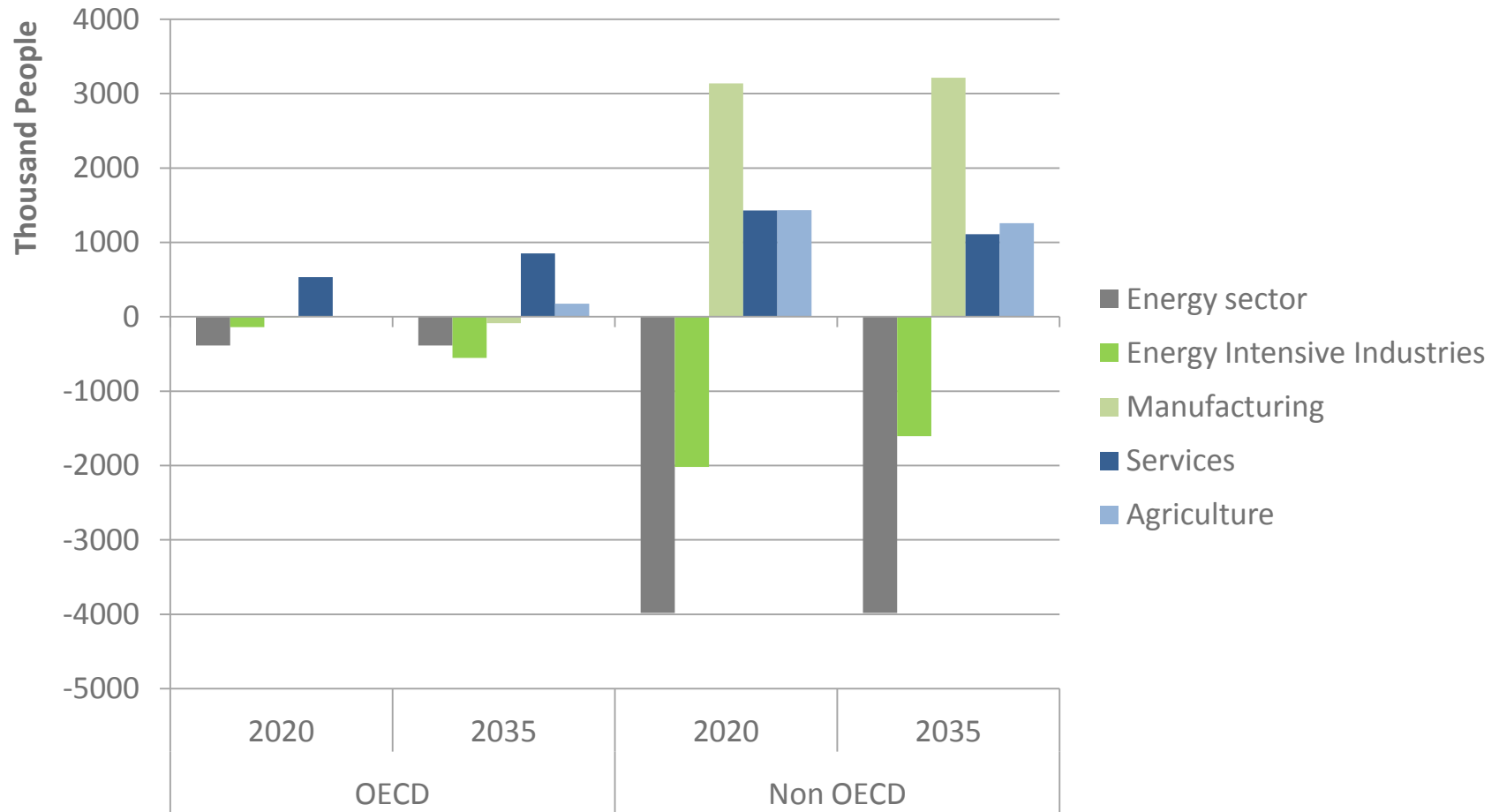
***Incentivized domestic production of services or manufactured products
reduce demand for imported goods (re-localization) + reduction of energy imports***

➡ Global trade is reduced by 2%



Shifts in employment by aggregated sectors

Efficient World Scenario relative to the New Policies Scenario



***Relatively modest reallocation of employment accross sectors
under assumption of fixed labour supply (no job creation)***



Conclusion

- Capital inflow induces country and sectoral reallocation of activity
- Overall GDP increase by 0.4%:
 - ⇒ Global economy benefits overall but the impact differs across countries: About +0.5% to 2% in OECD countries, up to +2% to +3% in China/India
- Global trade reduced by 2%
 - ⇒ Reduction of fossil-fuel trade + Enhanced demand for domestic production of less energy-intensive goods and services
- Further work:
 - ⇒ Additional scenario without fossil-fuel reform
 - ⇒ Extension to a 25 regions-model & Update of country results
 - ⇒ Forthcoming as OECD Working Paper

“Economic implications of the IEA Efficient World Scenario”



THANK YOU!

FOR FURTHER INFORMATION:

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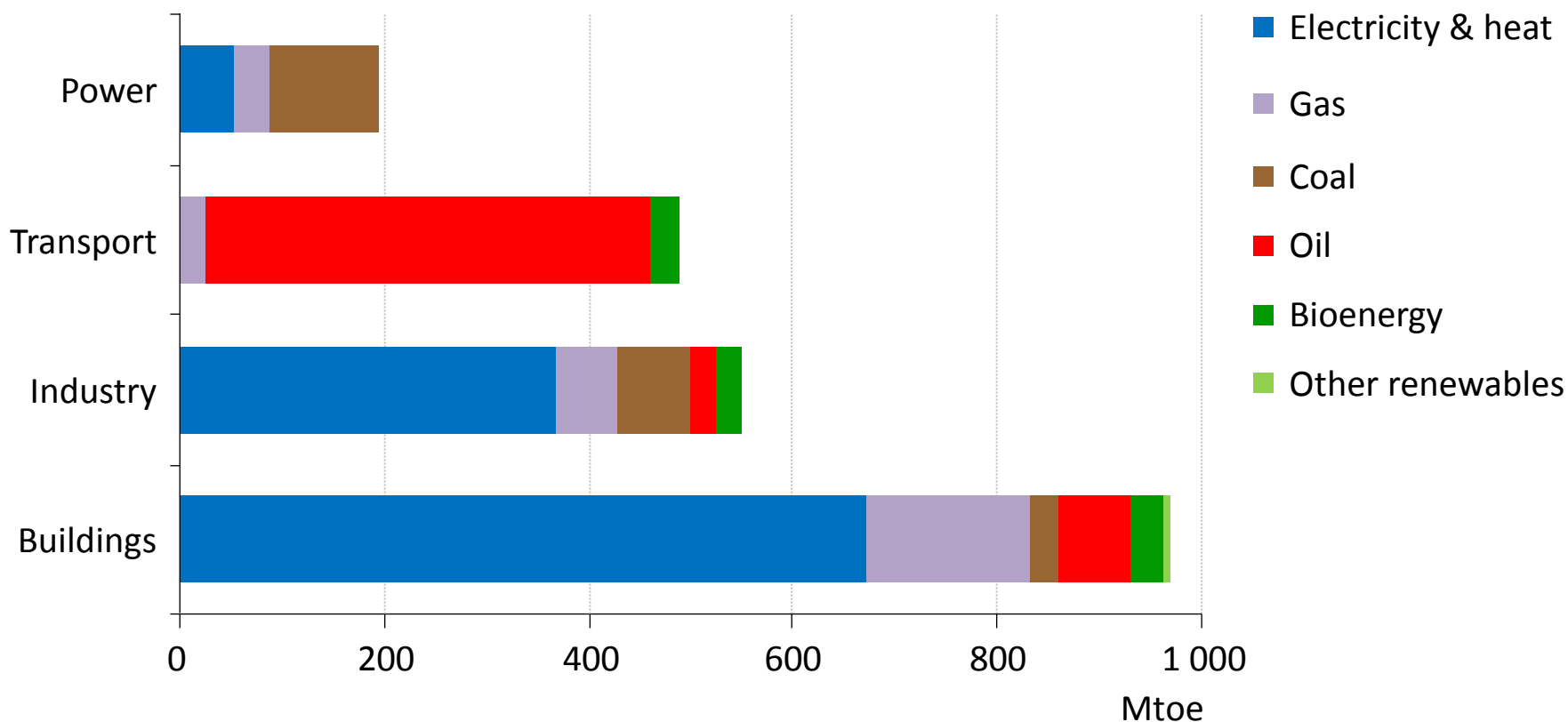
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Energy savings in 2035

Efficient World Scenario relative to New Policies Scenario



Source: IEA (2012)



Impacts on Intermediate and final demand by good or service in China

Efficient World Scenario relative to the New Policies Scenario (2020 and 2035)

