Structural change, international trade, and other insights from ENV-Linkages

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The OECD-ENV modelling toolkit and baseline construction

Modelling tools at OECD-ENV

Key models used by the ENV modelling team:

- ENV-Growth (macro, 180+ countries)
- ENV-Linkages (structural, 25 regions)

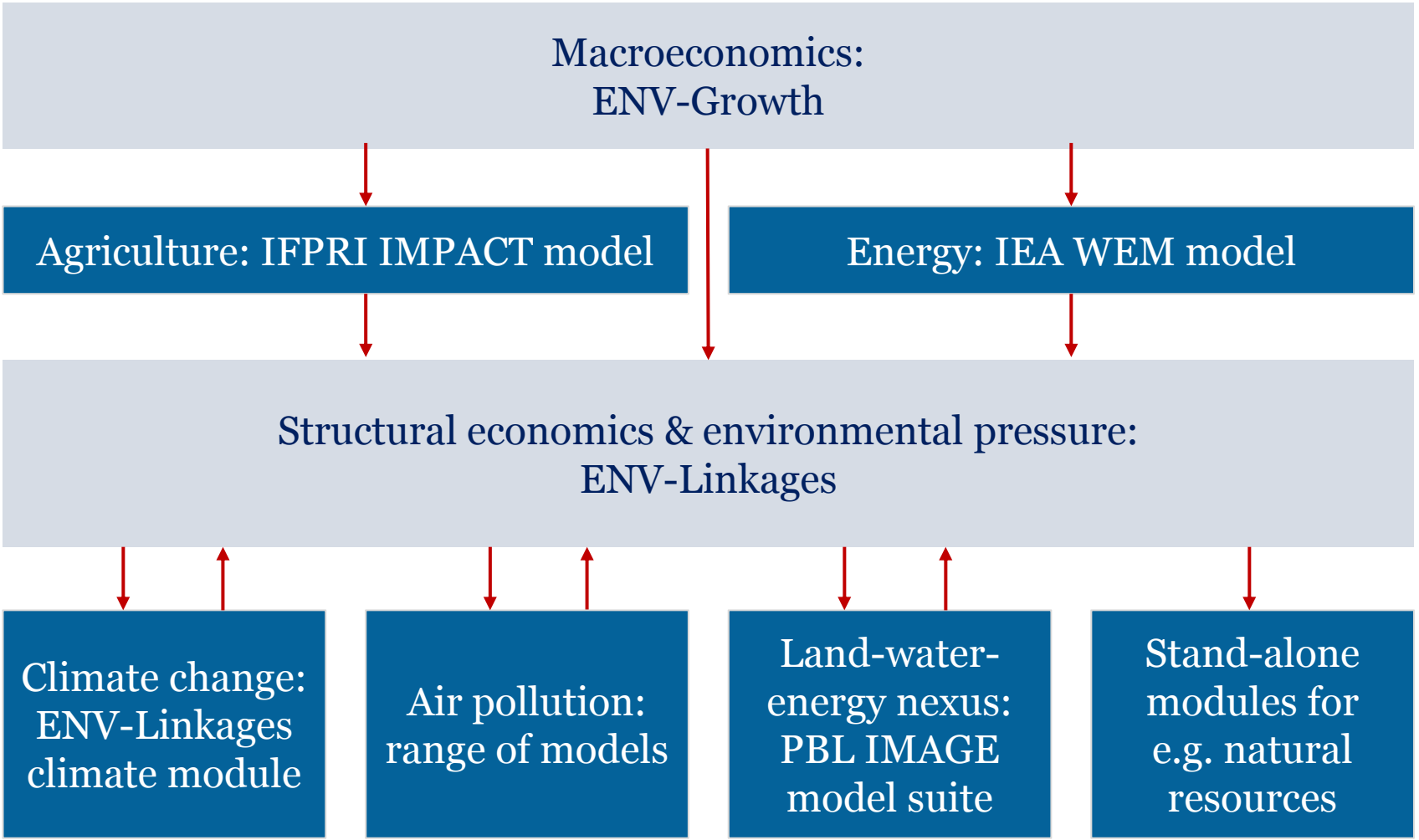
Interact with other models such as

- OECD ECO, TAD (incl. AgLink-COSIMO)
- PBL – IMAGE
- IFPRI - IMPACT
- FEEM – ICES, WITCH
- CERE – AD-DICE, AD-RICE
- IIASA – GAINS, potentially other models
- NIES – AIM
- [open for other partners]

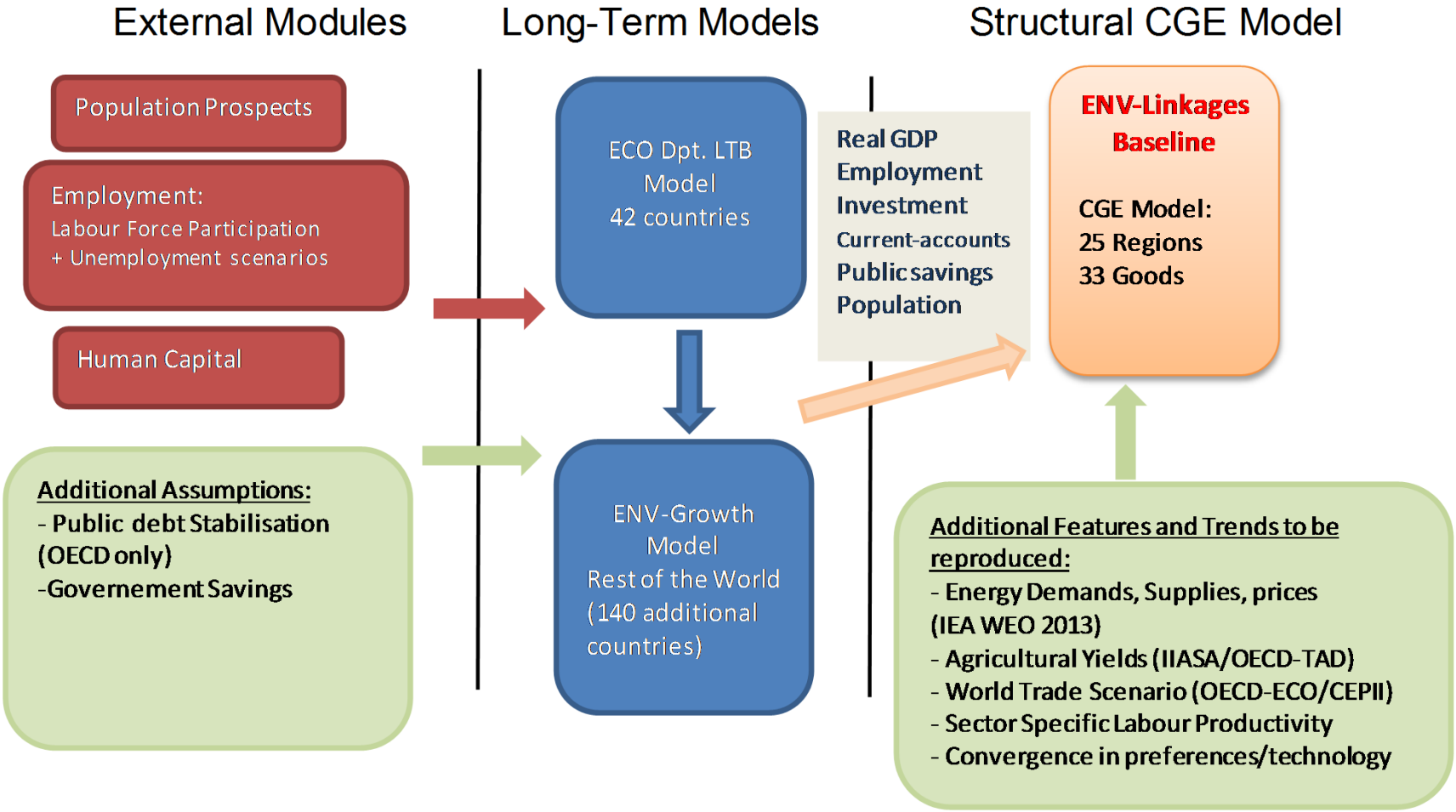
OECD ENV modelling tools:

- *ENV-Growth Model*: to generate long run macro-scenarios:
  - Outputs: GDP, aggregate savings, current account, labour supply, exchange rate, GDP deflator,…
  - Methodology: Mix of a potential output projection model based on conditional convergence of generic economic growth models + a transitional convergence module (OECD ECO dpt)
  - Standard utilization : OECD SSP's projection of GDP, OECD@100 report.
- *ENV-Linkages Model*:
  - dynamic CGE Model : 40 sectors (including 5 electricity tech. and 8 crops sectors) and 25 regions (IEA World Energy Outlook regions). Vintage capital, dynamic up to 2060
  - Outputs: sectoral value added and prices, environmental emissions, energy carriers, environmental feedbacks (climate and air pollution).

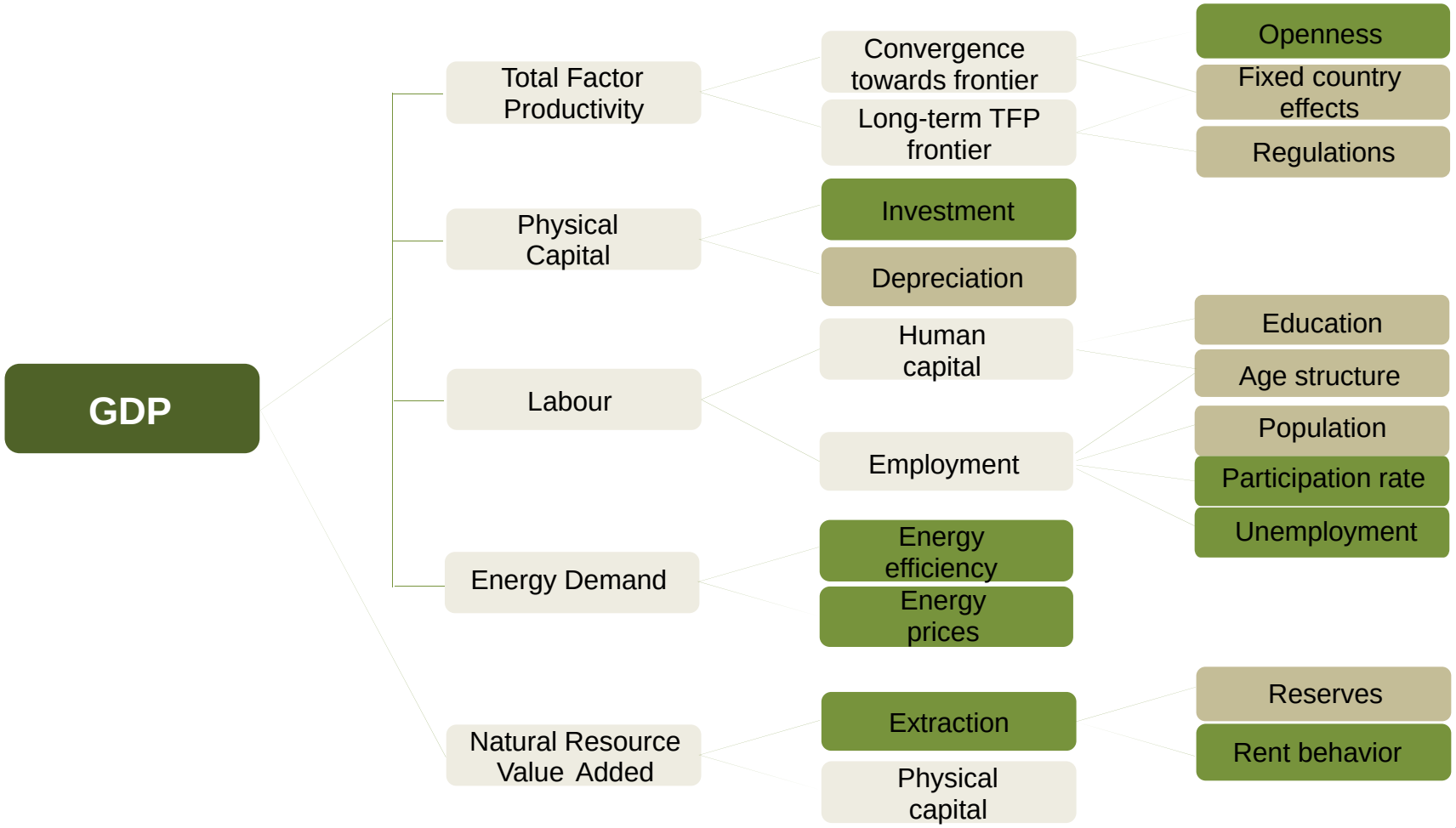
The first stages of the modelling track



Overview of the articulation of models and assumptions

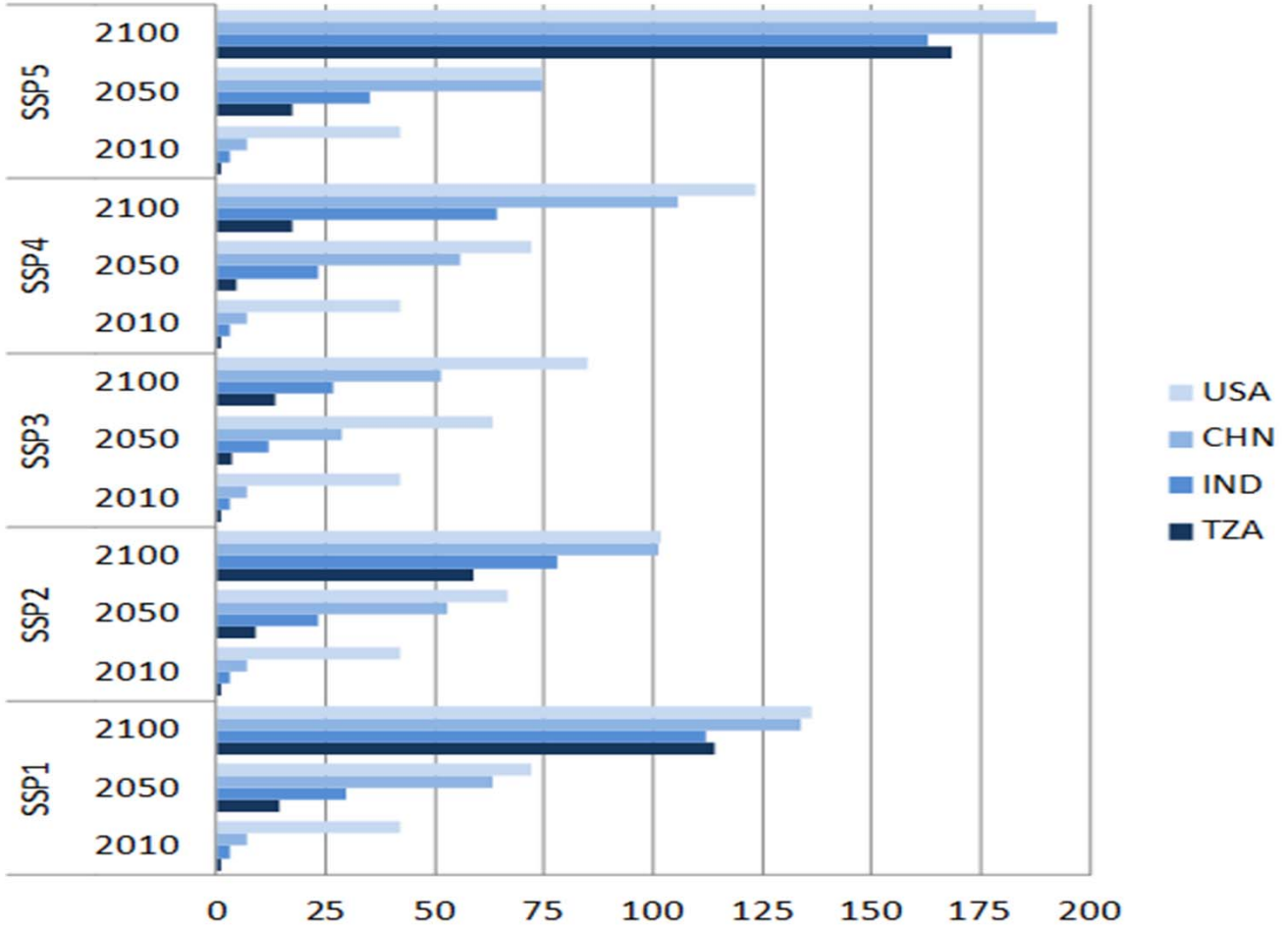


The ENV-Growth model



A stand-alone application of ENV-Growth: OECD potential GDP illustrating SSPs

Income levels in selected countries across the five SSPs (2005 USD)



Source: OECD ENV-Growth Model - IIASA online SSP Database

Structural projections: the ENV-Linkages model (25 regions)

- Computable General Equilibrium (CGE) model
  - Multi-regional, multi-sectoral (details in next presentation)
  - Full description of economies
  - All economic activity is part of a closed, linked system
  - Simultaneous equilibrium on all markets
  - Structural trends, no business cycles
- Dynamics
  - Solved iteratively over time (recursive-dynamic)
  - Capital vintages
- Link from economy to environment
  - Greenhouse gas and air pollution emissions linked to economic activity
  - Also includes (some) feedbacks from damages on economy

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Env-Linkages regional aggregation for Circle

OECD regions

United States of America
Canada
Mexico

Chile

Japan

South Korea

Australia and New Zealand

OE5: Other OECD Europe (Iceland, Norway, Switzerland and Turkey and Israel)

EG4 (France, Germany, Italy and the United Kingdom.)

E17: Other OECD EU (Austria, Belgium, the Czech Republic, Denmark, Estonia, Finland, Greece, Hungary, Ireland, Luxembourg, Netherlands, Poland, Portugal, Slovak Republic, Slovenia , Spain, and Sw eden.)

Non-OECD Regions

Brazil
China
India

EU7: European Union Non OECD (Bulgaria, Croatia, Cyprus, Latvia, Lithuania, Malta, and Romania)

Russia

OEU: Non-EU Eastern Europe (Albania, Belarus, Bosnia and Herzegovina, Gibraltar, the Former Yugoslav Republic of Macedonia, the Republic of Moldova, Serbia and Ukraine)

Middle-East (Bahrain, the Islamic Republic of Iran, Iraq, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, the United Arab Emirates and Yemen)

Indonesia

ASEAN9: Other ASEAN countries (Brunei Darussalam, Cambodia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam)

ODA: Other Developing Asia (Bangladesh, Chinese Taipei, the Democratic People's Republic of Korea, Mongolia, Nepal, Pakistan, Sri Lanka and other non-OECD Asian countries)

Caspian (Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan)

North-African (Algeria, Egypt, Libya, Morocco and Tunisia)
South Africa

OAF: Other African Countries (Angola, Benin, Botswana, Cameroon, Congo, Democratic Republic of Congo, Côte d'Ivoire, Eritrea, Ethiopia, Gabon, Ghana, Kenya, Mozambique, Namibia, Nigeria, Senegal, South Sudan, Sudan, United Republic of Tanzania, Togo, Zambia, Zimbabwe and other African countries)

OLA: Other Latin America (Argentina, Bolivia, Colombia, Costa Rica, Cuba, the Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Jamaica, Netherlands Antilles, Nicaragua, Panama, Paraguay, Peru, Trinidad and Tobago, Uruguay, Venezuela and other Latin American countries)

Env-Linkages sectoral aggregation for Circle:

Agriculture

Paddy Rice
Wheat and meslin
Other Grains
Vegetables and fruits
Sugar cane and sugar beet
Oil Seeds
Plant Fibres
Other Crops
Livestock
Forestry
Fisheries

Natural Resources and Energy

Coal
Crude Oil
Gas extraction and distribution
Other mining
Petroleum and coal products
Electricity (7 technologies#)

Manufacturing

Paper and paper products
Chemicals
Non-metallic minerals
Iron and Steel
Metals n.e.s.
Fabricated metal products
Food Products
Other manufacturing
Motor vehicles
Electronic Equipment
Textiles

Services

Land Transport
Air and Water Transport
Construction
Trade Other Services and Dwellings
Other Services (Government)

Fossil-Fuel based Electricity ; Combustibe renew able and w aste based Electricity ;
Nuclear Electricity; Hydro and Geothermal ; Solar and Wind ;
Coal Electricity w ith CCS ; Gas Electricity w ith CCS

From the macro scenario to the CGE model: principles of baseline constructions

- Use the macro database in ENV-Linkages model and complete with additional projections and assumptions.
- The “baseline” simulation of the CGE should reproduce the “macro-economic baseline”. To obtain this we let some structural parameter adjust to “calibrate” macroeconomic drivers. Examples: Labour Efficiency will adjust to fit the labour productivity projection / energy efficiency adjust to match projections about energy demands,…
- We then run the CGE model but adjusting some other structural parameters of the model to reproduce some stylized facts on structural change in the economy

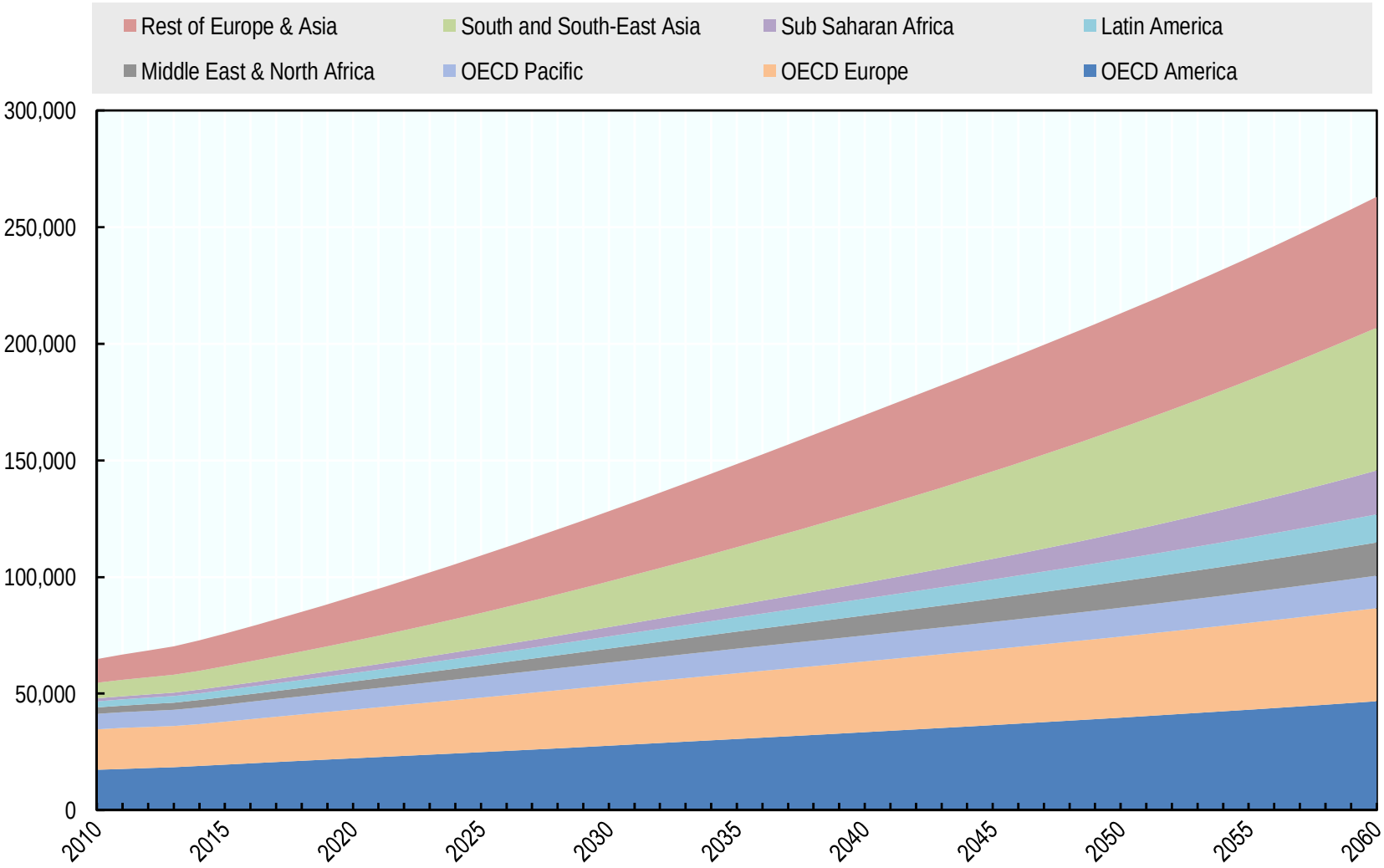
Structural change in ENV-Linkages

- Changes in household behaviour
  - Can't assume that income elasticities remain the same in emerging and developing countries
  - Convergence assumption on preferences (income elasticities)
  - Reproduce some stylised facts
  - Still plenty room for improvement: improve ELES structure, map sectoral output (commodities) to consumption categories, …
- Changes in production behaviour
  - Technological progress in production function
  - Calibrate agriculture to IMPACT
  - Calibrate energy to WEM
  - Capacity constraints for certain sectors (e.g. nuclear)
  - Reproduce stylised facts, e.g. on trade patterns, share of services in GDP, …

Economic activity: international trade

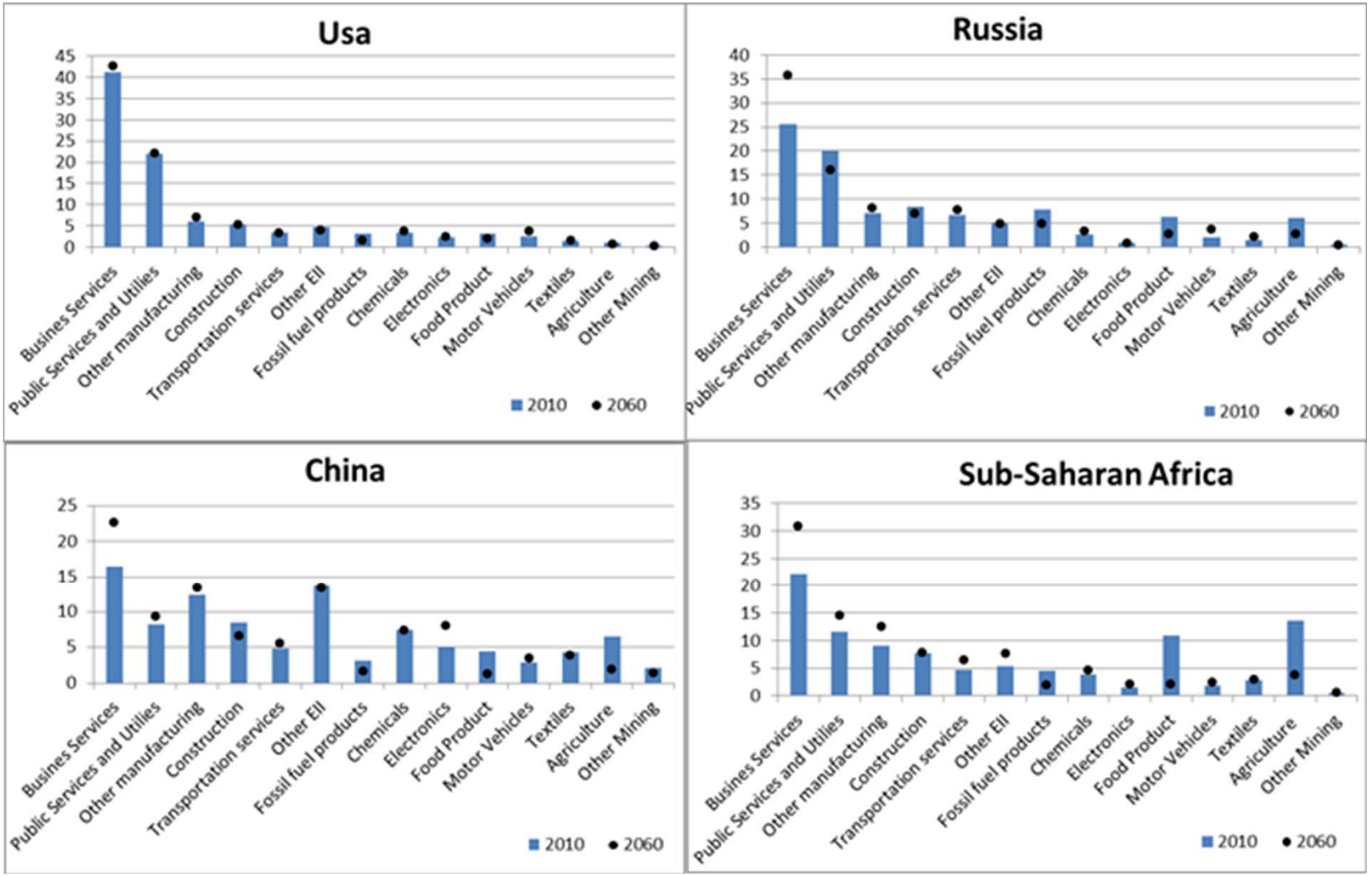
- Model represents bilateral trade flows
  - Basic assumption: goods from different regions are imperfect substitutes (Armington assumption)
  - Trade balance (international capital flows) is exogenously given; real exchange rates adjust
  - Import prices depend on world market price, tariffs/taxes/subsidies, transport margins and 'iceberg' costs
- Describing trade patterns realistically is difficult
  - Advantages of Armington approach: avoids pure specialization and other extreme fluctuations in trade patterns from small price changes across regions
  - Potential problem: initial trade shares influence future trade flows

Baseline projection of GDP



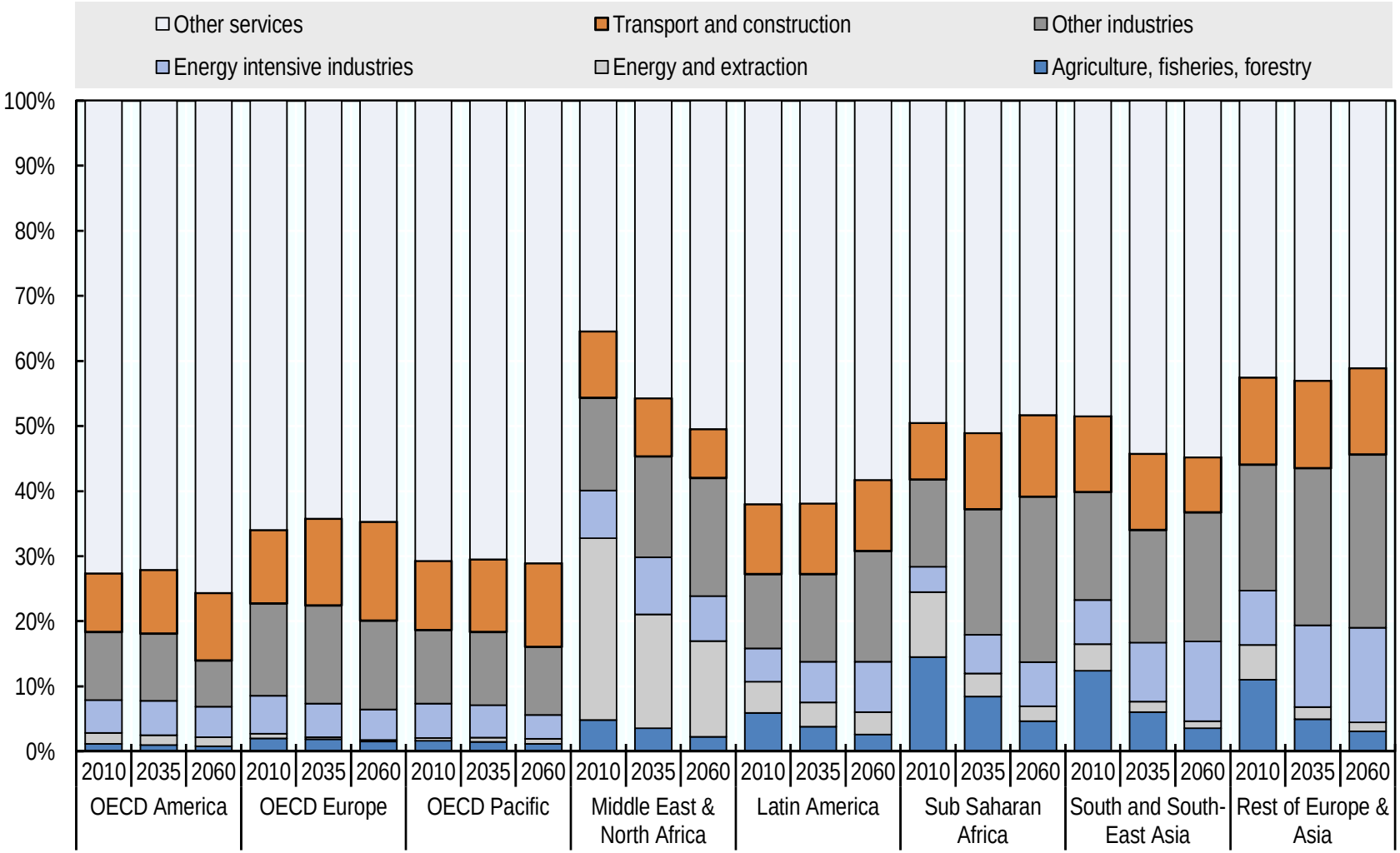
Source: ENV-Linkages calculations

Baseline projection of consumption



Source: ENV-Linkages calculations

Structural change in the baseline



Source: ENV-Linkages calculations

Linking IMPACTv3 and ENV-Linkages

1. Run IMPACT with ENV-Growth macro baseline
2. Use IMPACT land supply elasticities to calibrate ENV-Linkages production function
3. Harmonise assumptions on secondary demand (food, textiles, etc.) and demand for crops by these sectors
4. Calibrate ENV-Linkages demand parameters to reproduce IMPACT projected trends (consumption, livestock feed, etc.)
5. Calibrate ENV-Linkages production parameters parameters to reproduce IMPACT projected trends (land supply, land efficiency, effective yields/TFP)
6. Do not harmonise trade patterns due to model differences

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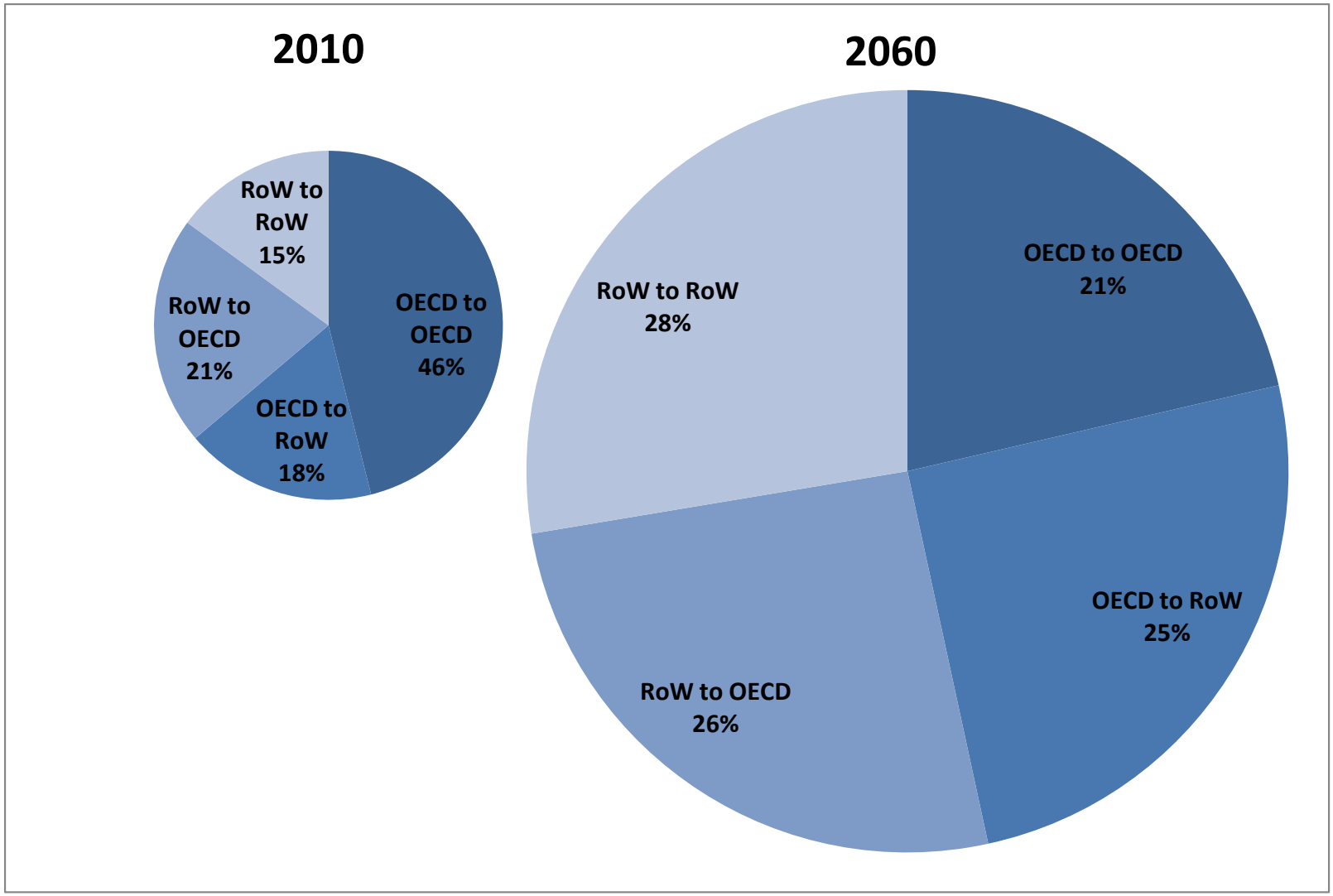
Changing trade flows in the baseline



Source: ENV-Linkages calculations

First PART: GENERAL OVERVIEW of OECD – IEA common modelling work

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Why Linking a CGE Model and a PE model is important for energy issues:

- This Presentation is about the original linking of two models: the IEA energy-oriented Word Energy Model (W.E.M.) and the OECD C.G.E. Model ENV-Linkages (E.L.)
- Top-Down and Bottom-up models are used to answer to different questions:
  - BU: Analyze long-term detailed energy projections/scenarios
  - TD: Economic consequence of energy markets and energy/climate policies on GDP, sectoral re-allocation, trade…
- Linking both models helps to consider energy issues in a large panel of consequences.
- Different degrees of linking the two kind of model could be considered.

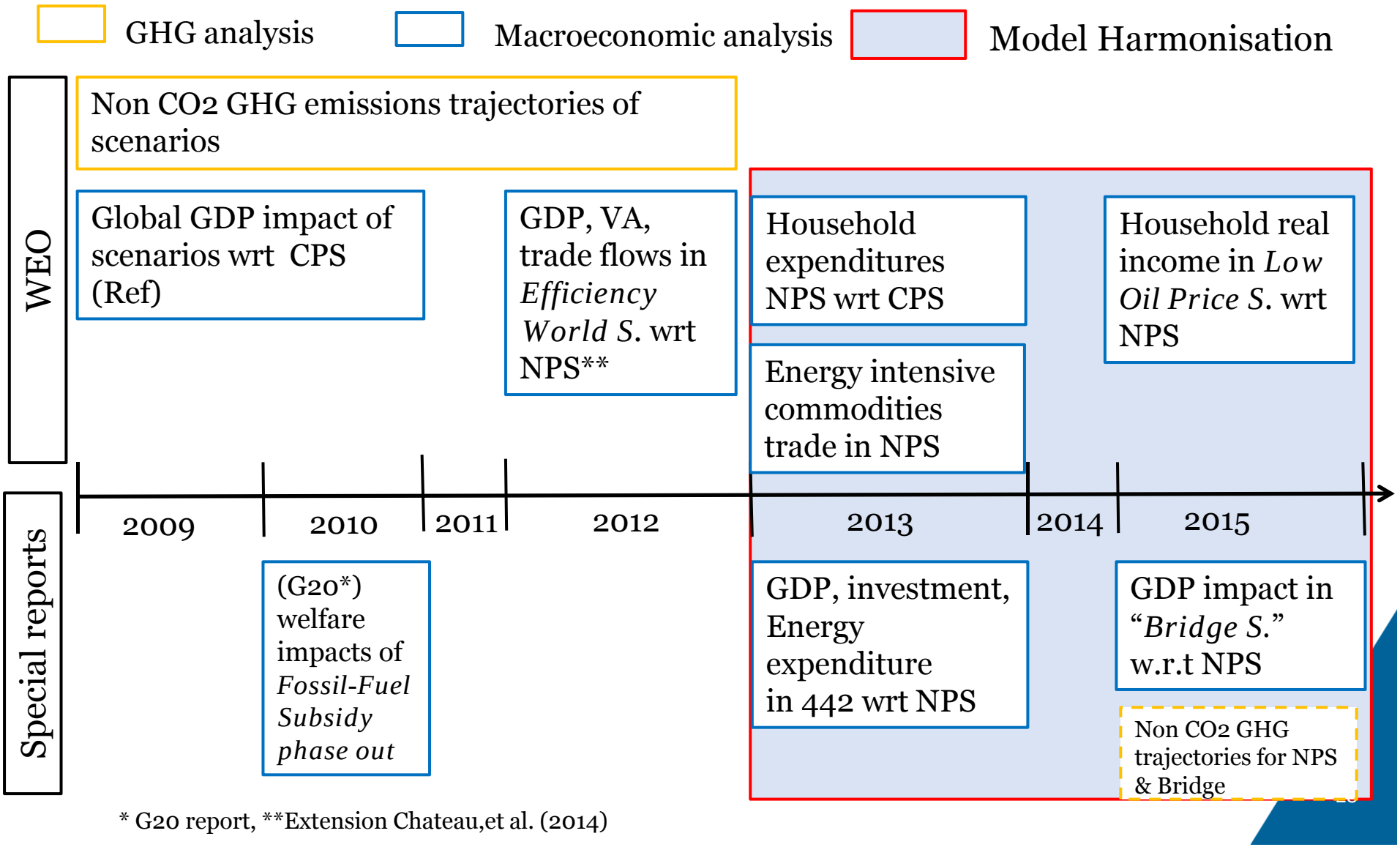
Basic Ideas about the differences in structures and the difference of uses of IEA and OECD models

	IEA-WEM	OECD-ENV-Linkages
	Simulation	**Optimization**
	Based on empirical and had hoc relationships	-Based: agent's rational behavior
+	-Replication on the short run -Flexibility of relationships used	-Consistency on the long run -Explanation based on economic theory
-	-Control over long-run trajectories -Per se Trade + supply – demand -Description rather than explanation	-Consistency on the short run -Rigidity: the relations restricted by theory + ensure convergence
	Bottom-up (BU)	**Top-down (TD)**
	Technologies and physical units	Monetary aggregates + macro functions
+	-Replication of energy flows -Translation of of tech & policies	-Reproduce monetary flows data bases -Possible to do sensitivity analysis
-	-Representation fit for some sectors only + bound definition	-Translation of tech and policies -Consistency with physical laws

Brief description of ENV-Linkages and WEM models

	ENV-Linkages (CGE)	WEM (PE)
Regions/time	25 – Horizon 2060	25 – Horizon 2040
Accounting	Monetary flows by product (SAMs)	Energy flows by product and type of use (EDC)
GDP & VA	Model output Calibration • Baseline GDP based on ENV-G model • VAs driven by productivity & demand	Model input Calibration • Fixed GDP & VA by broad categories based on exogenous projection. • + Expert judgement for sectorial impacts
Energy demand	• By institutional sector (households, industries, government) • By products (coal, oil, gas, elec, oil prod)	By sector & use (residential, transportation, industries) By products (many)
Energy supply	Top-down (USD flows + macro function) • Power = 5 types of generation • Fossil fuel supply: TD coal, oil, gas, • 1 fuel processing sector (>refining)	Bottom-up (physical flows, technologies) • Power: heat and electricity technologies • Fossil fuel supply : based on field by field • Refining model
Other sectors	35 sectors (8 agriculture, 10 services)	8 (6 industries+ agriculture+ services)
Emission coverage	• CO2 from fuel combustion • CO2 from other sources • Other Kyoto GHGs (CH4, N2O,…) • Local Air Pollutants	• CO2 emissions from fuel combustion • Some process CO2 emissions • Upstream energy sector CH4 emissions

ENV-Linkages for World Energy Outlooks scenarios: summarized historical view



* G20 report, **Extension Chateau,et al. (2014)

2 approaches were used so far in the collaborations between OECD and IEA (1)

- A .No Linking : use the two models in parallel:

  Same scenario for both models and weak harmonization of the data and the baseline projections. Then look at different output for the two models. Examples:

  – Simulation of the 450 scenario from the WEO2010: Energy demand and supply from W.E.M. vs Total GHGs emissions from E.L.

  – Fossil fuel subsidy removal for 2010 G20 report, CO2 to 2020 from W.E.M. / Welfare Impacts in 2050 from ENV-Linkages.

2 approaches were used so far in the collaborations between OECD and IEA (2)

- <u>B) Soft Top-Down Linking:</u>

  Reproduce with EL the energy demands and supplies from WEM scenarios then study the trade and macroeconomic consequences of these energy scenarios. Examples:

  – ENV-L used to represent implications of WEO in terms of monetary flow outside of the energy sectors of massive investment in energy efficiency or renewable (WEO 2012 and 2013)

  – Model outputs: variations in regional GDP, sectoral value added, competiveness impacts,…

  – Strong connection between energy sector development and cost so the risk of inconsistency is high

Utilisation of ENV-Linkages for World Energy Outlook reports

2 types of use: GHG and macroeconomic analysis

Examples:

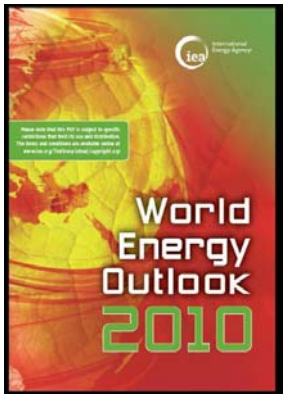
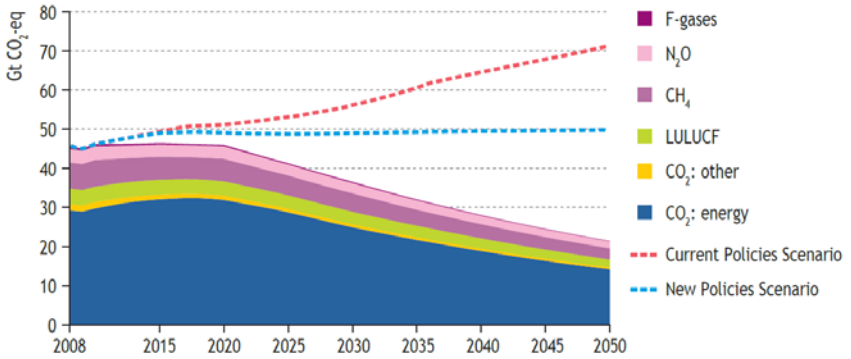


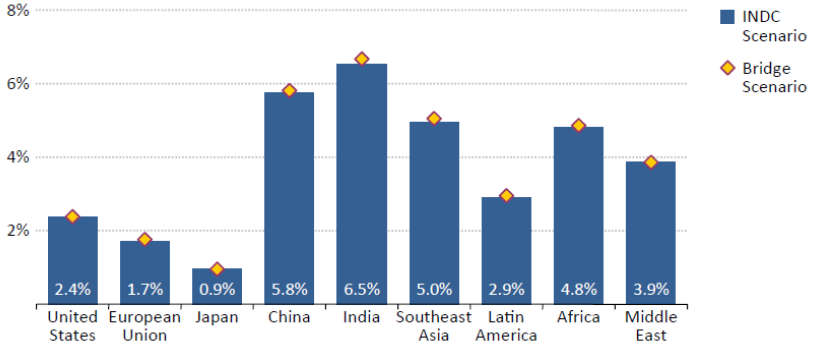
Figure 13.4 • World anthropogenic greenhouse-gas emissions by type in the 450 Scenario



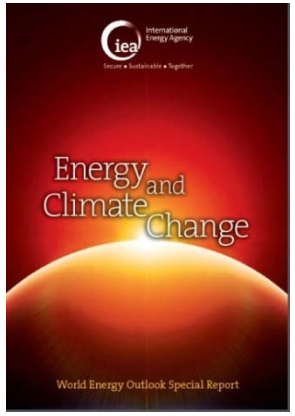
Note: F-gases include hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) from several sectors, mainly industry.

Sources: IEA-OECD analysis using MAGICC (version 5.3v2) and OECD Env-Linkages models.

Figure 3.17 ▷ Average annual GDP growth by scenario by selected region, 2013-2030

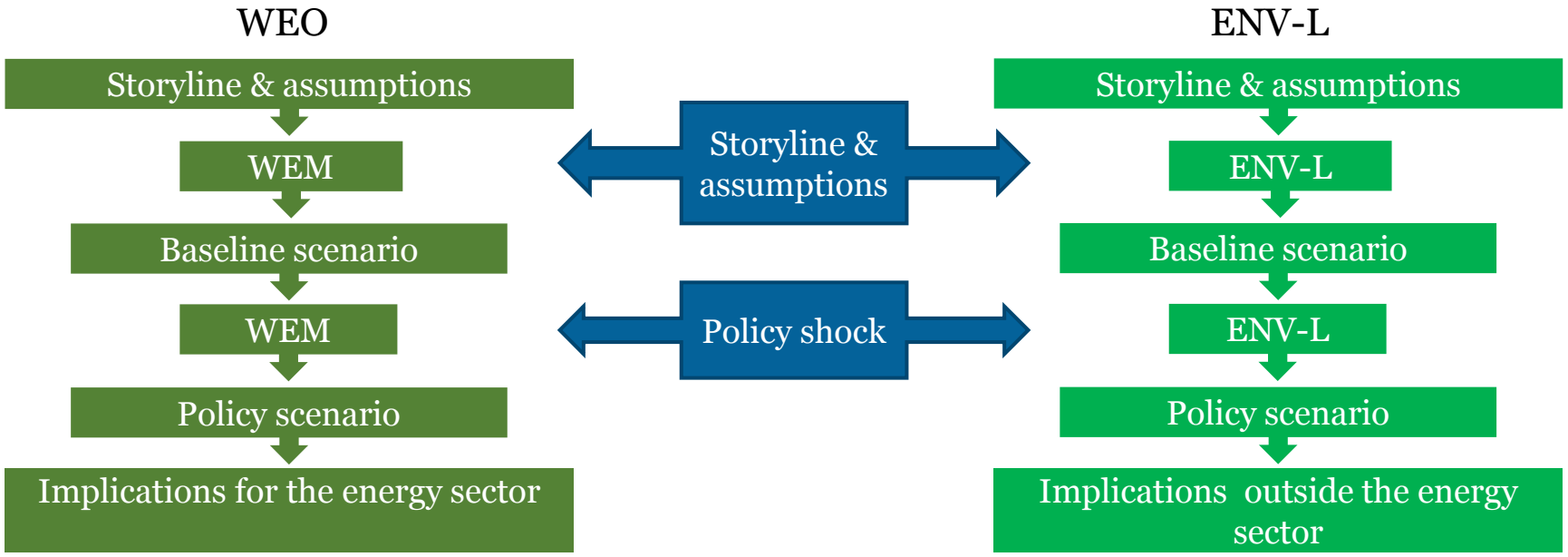


Source: OECD ENV-Linkages model. Growth rates are calculated on a PPP-basis.



WEM and ENV-L models in parallel

Align the reference (baseline) scenarios & run same policy shock



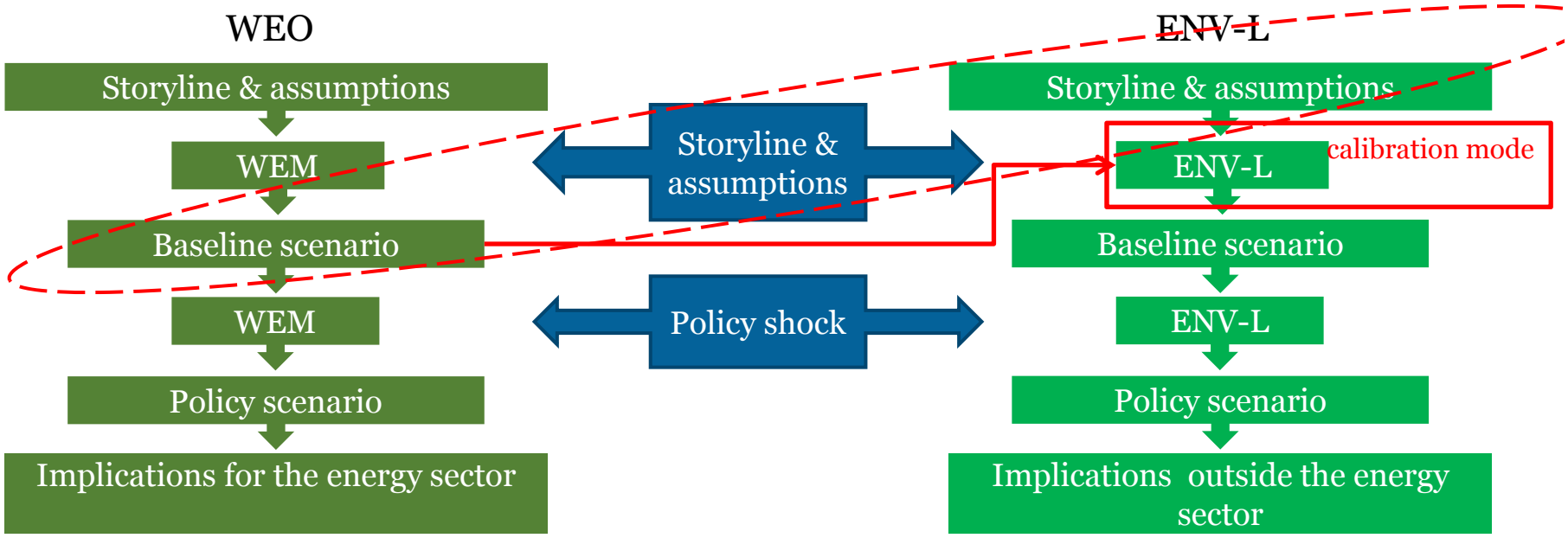
Baseline and policy scenario are in general loosely aligned

- Assumption and storylines shared very partially (they are mostly different)
- Assumptions for WEM can be results for ENV-L (and vice versa)
- Model responses to shocks are impossible to fully align (as the models are ≠)

Good option for policy analysis? depends on how the effect shown in ENV-L depends on the energy effects show in WEM eg: fine for GHG analysis, less for implications of WEM energy system costs for the economy

Calibration of ENV-L baseline scenario on WEM

Make the ENV-L baseline reproduce WEM baseline



Used to align energy supply, demand (Mtoe), international oil prices

ENV-L and WEM baseline share some common results, but most of underlying assumptions/driver are still different Eg : same energy consumptions in industry but different explanation in terms of activity price and autonomous energy efficiency improvement effects

Need to run ENV-L in calibration ie **reverse engineering: long and complicate process.**

Problems of interpretation may arise when too much part or ENV-L assumptions (technologies, preferences, endowment) are calibrated on IEA scenarios:

Conclusions

- IEA – OECD collaboration on linking both models is an ongoing process
- Collaboration has been reinforced these two last years by sharing a common position across the two modelling Team.
- Models harmonization is a very time consuming process and show some limits.
- Next Steps: two different approaches
  - In OECD: Still improve harmonization of the CGE on WEM features in order to run illustrative energy scenarios with EL in line with WEM
  - In IEA: Make the energy markets in EL exogenous, taking full set of WEM trends as given (eg. Soft-link but the two models will be run together)

Second PART: Modelling 2012-2013

IEA Energy Efficient World scenario (EWS)

ENV-WP No 64

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An Example of soft linking: Modelling the 2012 « IEA *Efficient World Scenario* »

- First step Calibration of ENV-Linkages Baseline to reproduce IEA CPS scenario
- Second Step simulations of two policy scenario, taking CPS trends, the NPS and EWS.
- Third Step comparisons of EWS with NPS only

Step 1: Calibration of the IEA "Current Policies Scenario" as a baseline for *ENV-Linkages*

- 1st run : Starting with common drivers for both models (GDP, POP,…) and same energy policy projections (Fossil fuel subsidies reform, renewable supports, carbon markets, regulations and power generation capacity building) with no further adjustments there is no chance that energy supplies and demands would coincide: both models are too different.
- 2nd run: Need to harmonize more, so we adjust ENV-Linkages scale parameters and elasticities

IEA trends projections	ENV-Linkages adjustment
Intermediate energy demands	Autonomous energy efficiencies
Fossil-fuel supplies	Fossil-fuel TFPs
International fossil-fuel prices	Fossil-fuel supply elasticities
Household energy demands	Income elasticities/minimum subsistence levels
electricity generation mix	TFPs / TWh generation demands

Preliminary simulation step on historical period 2004-2010 to reconcile IEA energy data in volume with GTAP SAMs

Step 2a: Simulation of two more IEA policy scenarios New Policies (NPS) and Efficient World (EWS)

✓ **Relative to the CPS : additional energy policies**

⇒ Gradual phasing-out of fossil fuel subsidies in non-OECD countries (different assumptions in both scenario for Russia and Middle-East)

⇒ More subsidies to renewable-based electricity in some countries

⇒ Additional sectorial carbon markets in some countries

⇒ Other regulatory instruments (e.g. fuel economy standards)

✓ **Additional "*Energy Efficiency*" oriented investments** relative to the CPS needed to reach energy-savings targets in the NPS or EWS scenario.

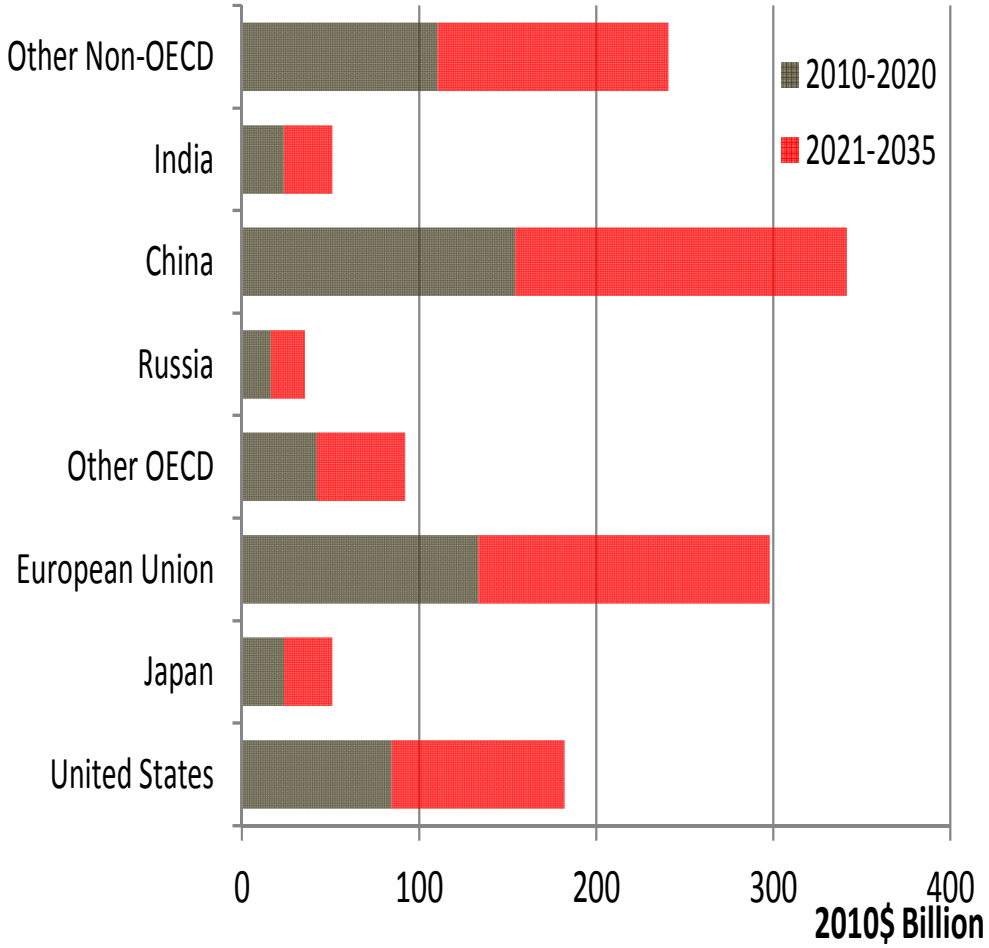
⇒ Increase of capital stock by sector (capital cost driven)

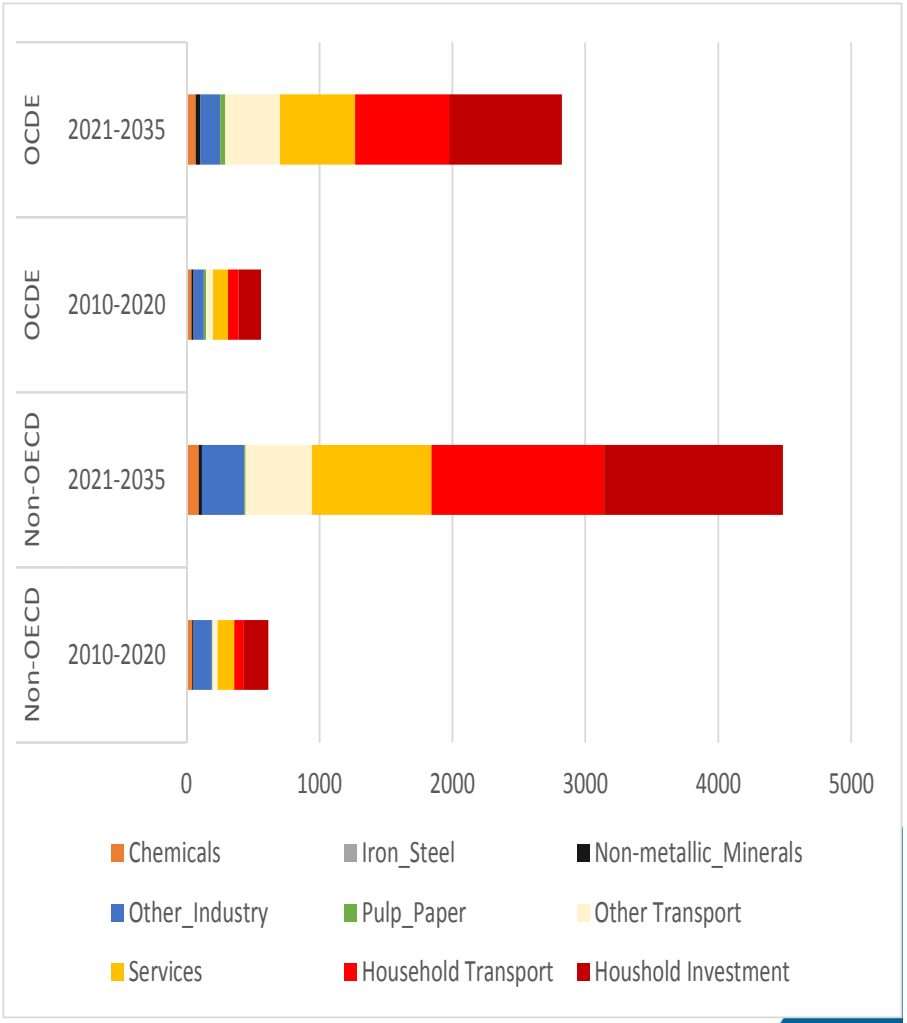
⇒ Final Demand Regulations on buildings, appliances and vehicles

Step 2b: Modelling strategy chosen for extra-Investment dedicated to energy efficiency

- In the standard ENV-Linkages version (CPS) :
  - National net saving determine total investment in “new“ capital
  - “New” capital is allocated across sectors such that return to new capital is equal for all sectors.
- In Energy-Efficiency version (NPS & EWS):
  - For some sectors, new capital is exogenously given, its value is calculated from IEA “*dedicated to energy efficiency improvements*” (relative to the CPS)
  - Energy efficient “New” capital returns are then endogenous and sector specifics.
  - Energy Efficiencies are endogenously determined to match energy demands of IEA scenarios.
- As a consequence capital allocation could not be efficient on aggregate basis relative to standard case (CPS).
- We only compare NPS and EWS : same model, no inconsistency
- For sake of honesty “saving-multiplier effect” is frozen: macro impacts only depend on distortive effects embodied in policies.

IEA scenarios (1): Additional investments in energy efficiency by country/sector in EWS relative to NPS

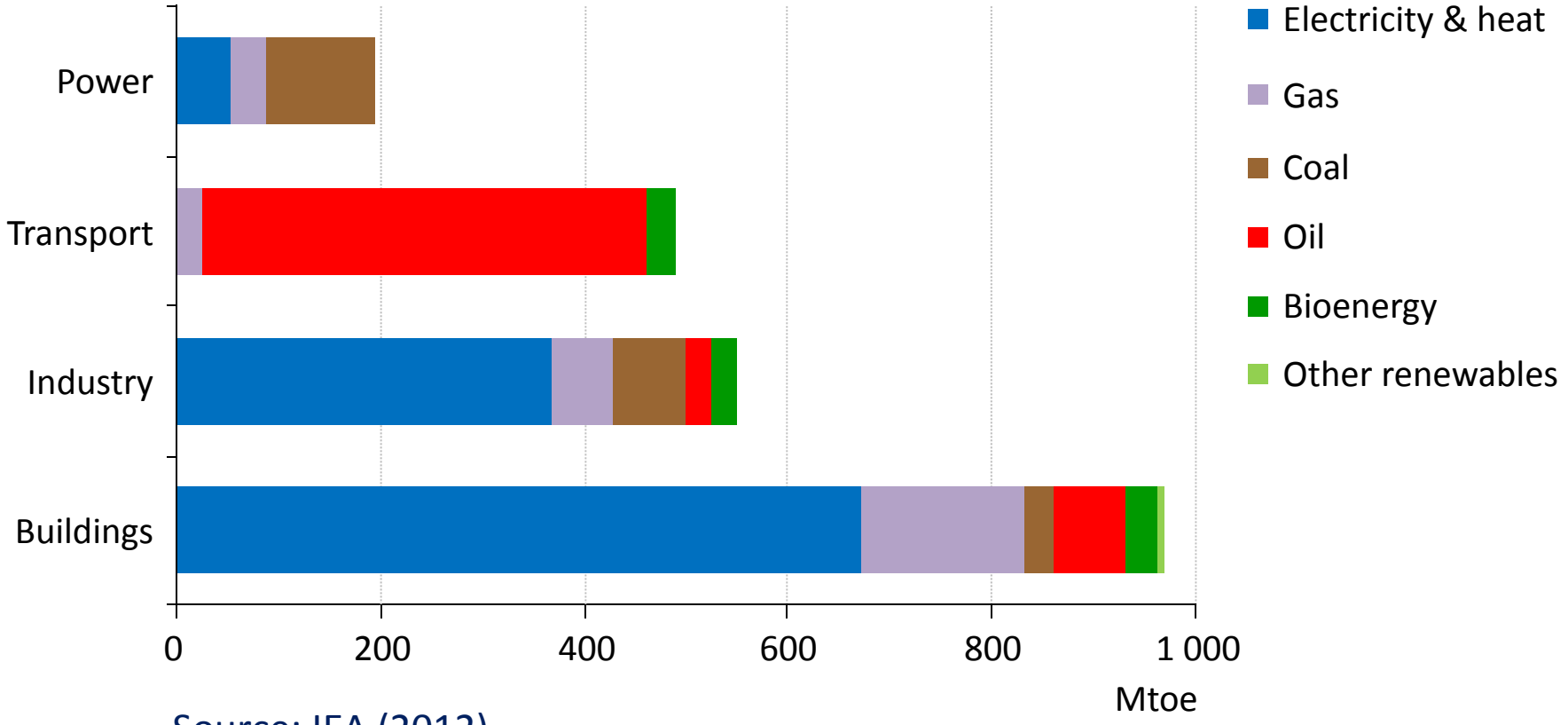




Source: IEA + OECD calculations

IEA scenarios(2): Impacts on energy savings in 2035

Efficient World Scenario relative to New Policies Scenario



Source: IEA (2012)

OECD ENV-Linkages: key channels of energy-efficient oriented investments on sectors activity

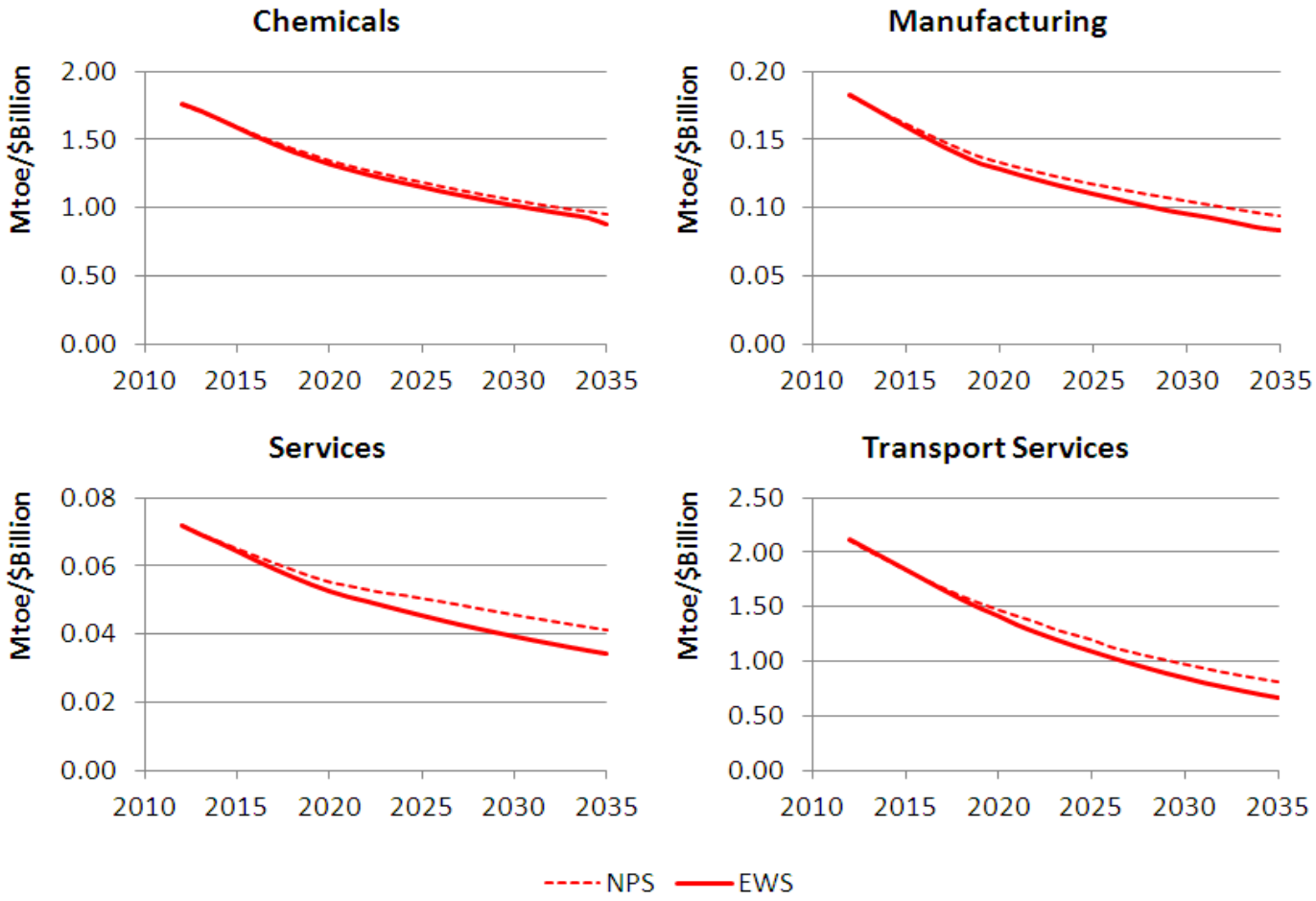
Two key policy-driven effects:

1. Direct Effect: extra investments result in **additional capital stock** and to a reduced energy bill in sectors where they are implemented
   - ⇒ Capital-energy substitution
   - ⇒ Reduction of production costs in capital intensive industries (generally, more abundant capital makes it cheaper)
2. Indirect Demand Effect: Households or firms investments are the result of purchases of some specific goods/activities (construction, equipment, softwares,…)
   - ⇒ **Additional demand** for goods or services from those sectors.

- Transport or Services: Effects 1 & 2
- Chemicals: Effect 1 only
- Construction : Effect 2 only (+ Cement through Construction)
- Energy industries: Effect 2 but negative

+ Additional Effects: Terms of trade changes, sectoral reallocation,…

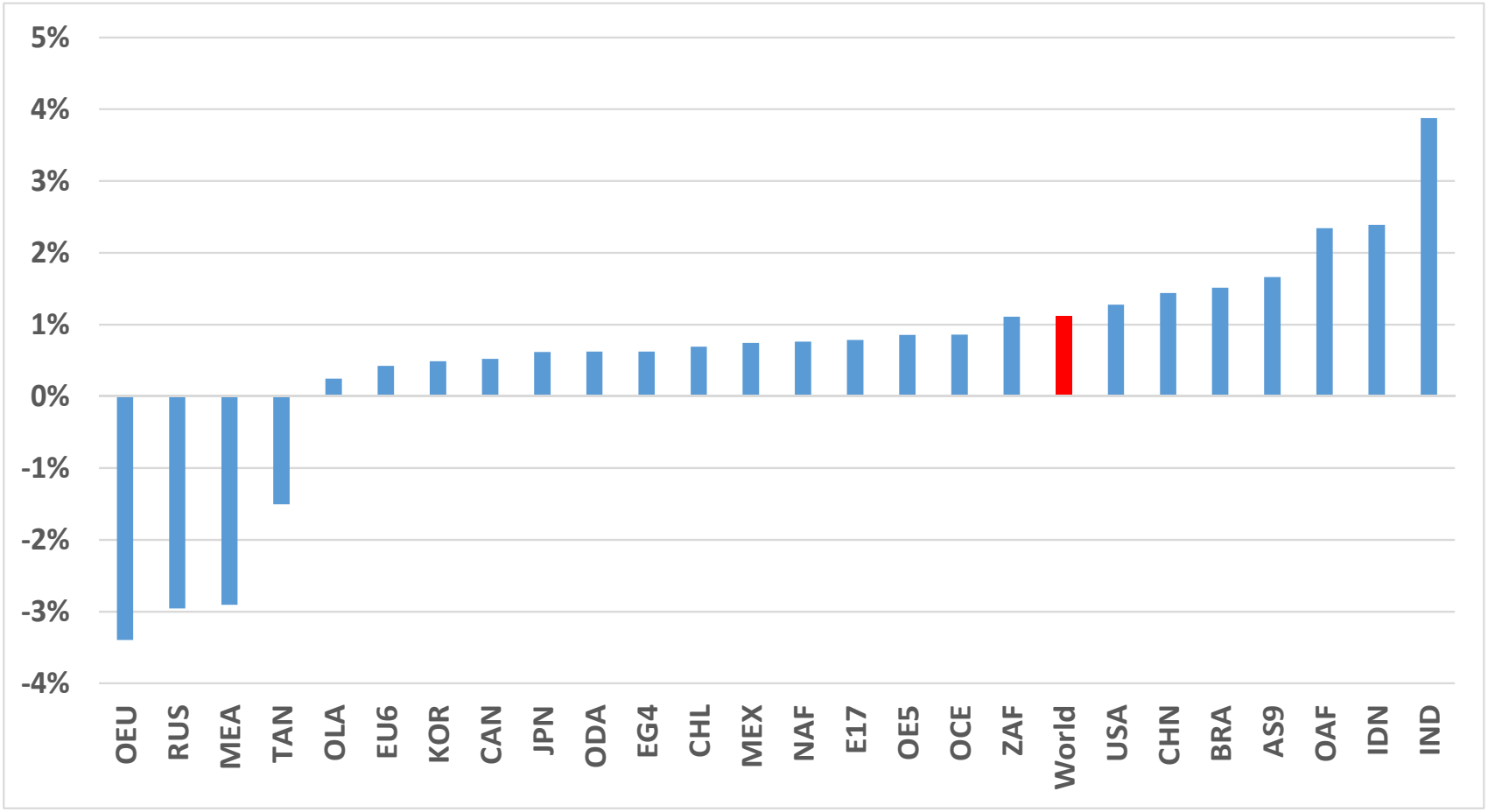
Global energy-capital ratio in the NPS and EWS for some production sectors



Source: OECD ENV-Linkage Model

% Real GDP Deviation in 2035

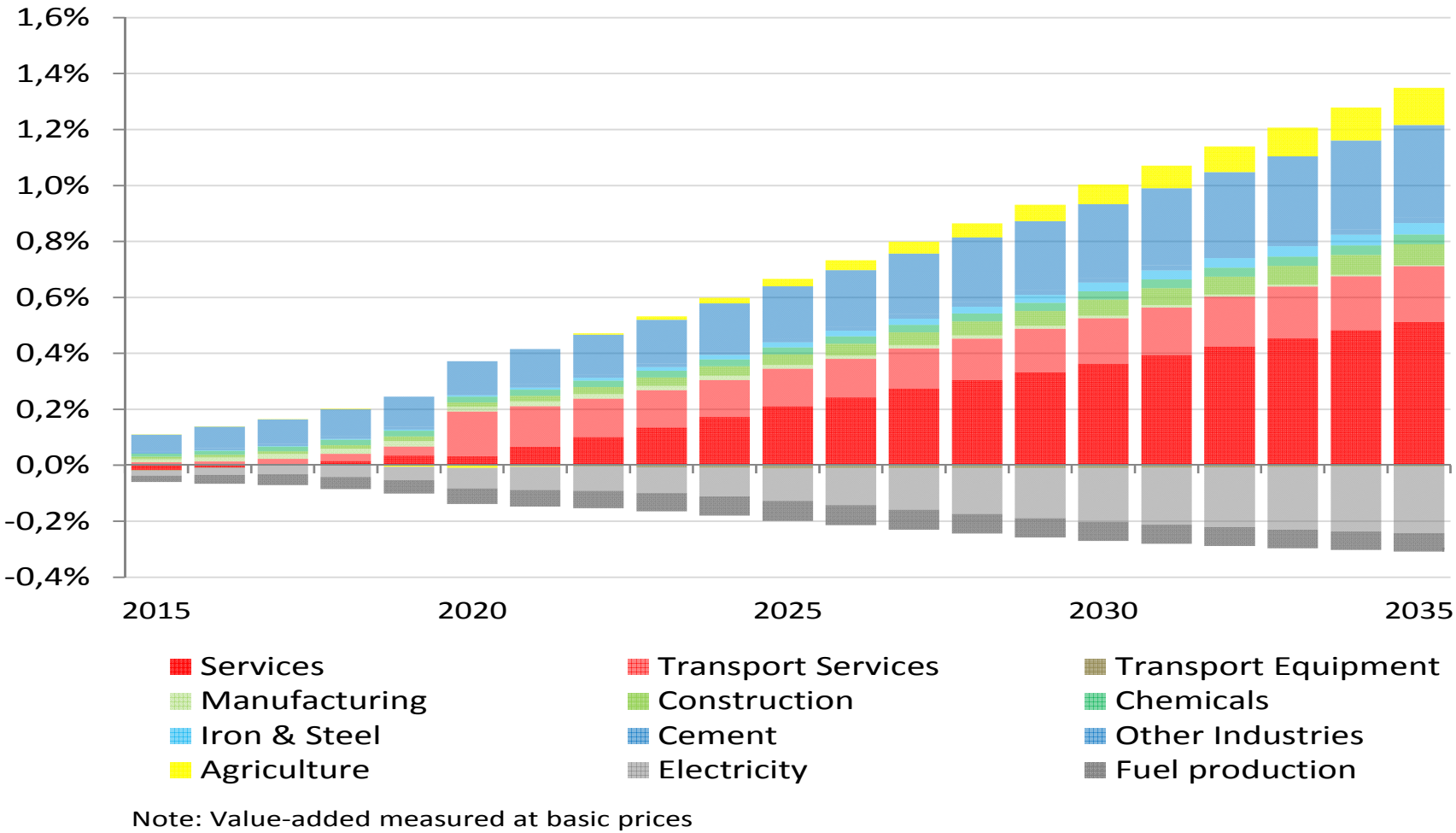
Efficient World Scenario relative to the New Policies Scenario



Source: OECD ENV-Linkage Model

%Change in sectoral real value added - United States

Efficient World Scenario relative to the New Policies Scenario

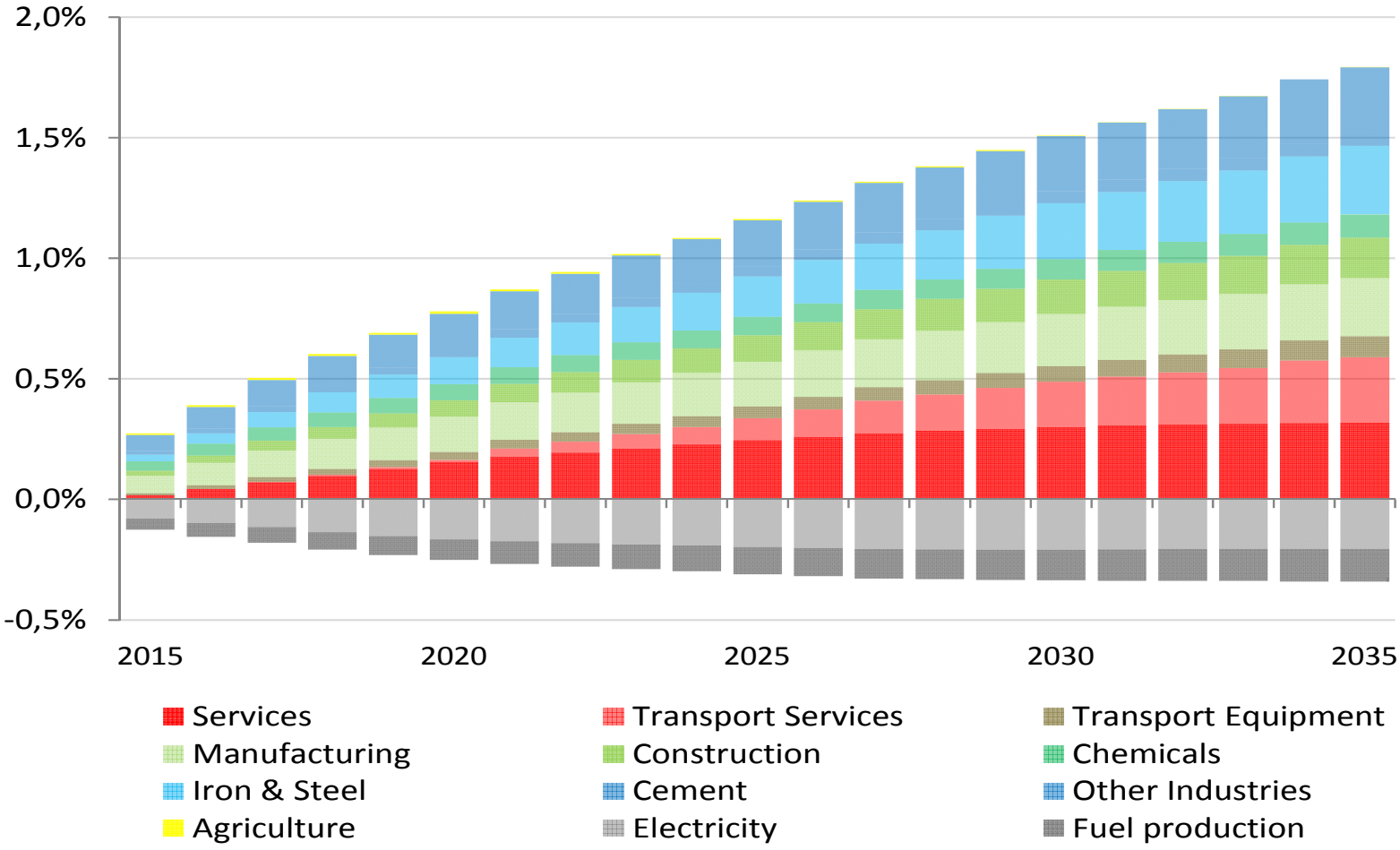


Note: Value-added measured at basic prices

Source: OECD ENV-Linkage Model

%Change in sectoral real value added - China

Efficient World Scenario relative to the New Policies Scenario

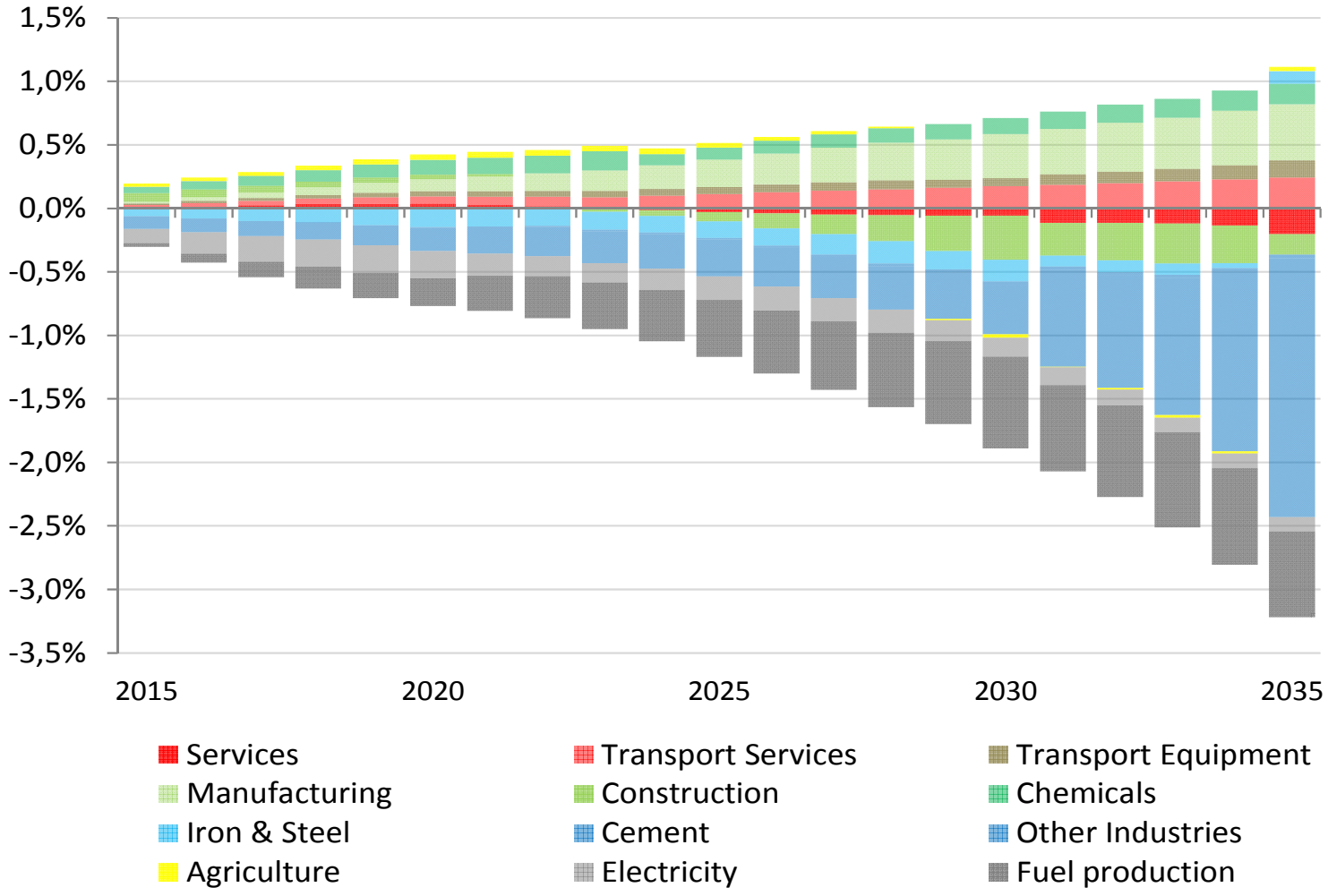


Note: Value-added measured at basic prices

Source: OECD ENV-Linkage Model

%Change in sectoral real value added - Russia

Efficient World Scenario relative to the New Policies Scenario

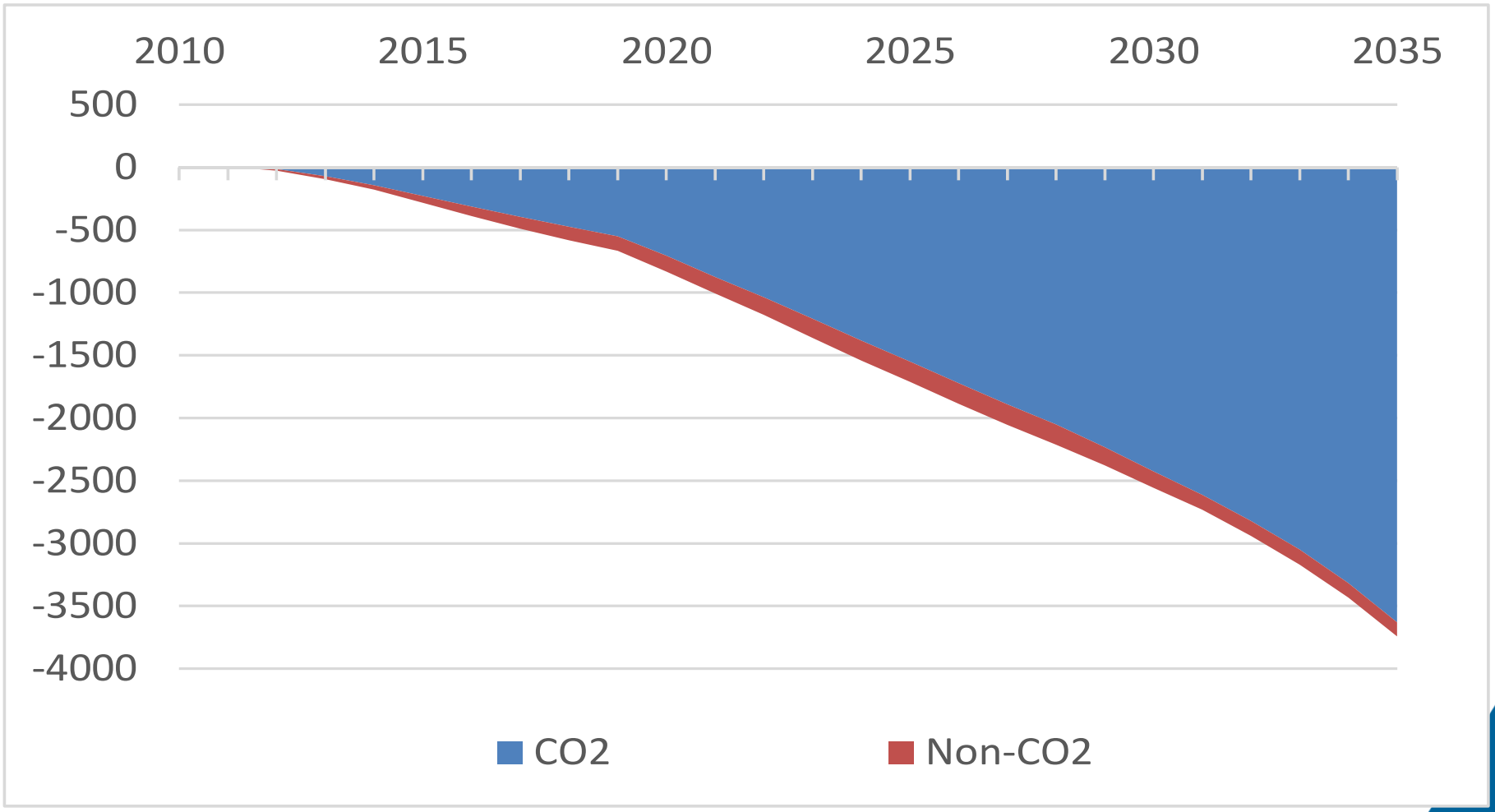


Note: Value-added measured at basic prices

Source: OECD ENV-Linkage Model

Impacts on GHGs (millions of ton of CO2 Eq.)

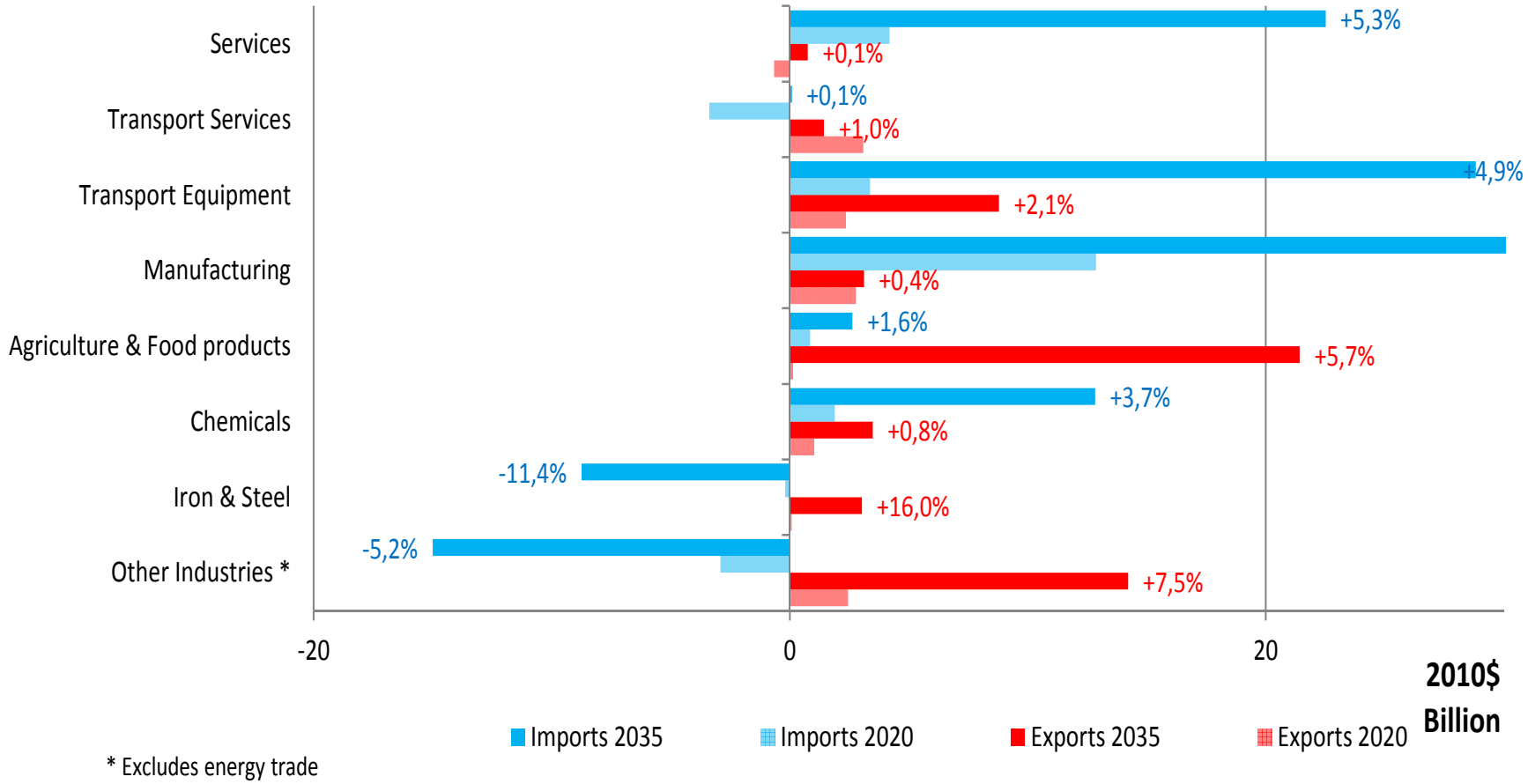
Differences: Efficient World Scenario vs New Policies Scenario



Source: OECD ENV-Linkage Model

%Change in sectoral trade - United States

Efficient World Scenario relative to the New Policies Scenario



* Excludes energy trade

Source: OECD ENV-Linkage Model

Conclusion

- Energy efficiency Investments imply small but positive allocative effects at worldwide levels
- Sectors and countries are not all positively impacted.
- Positive impacts on GHGs emissions as well as on air pollution (in IEA WEO)
- More experiments and insights in the WPNo 64.
- Actualization of this work for 2013 IEA report.
- Personal thoughts: positive gains would occur if we dedicated part of investment to energy efficiency but the present analysis do not deal with the issue of portfolio analysis of investment: these so small gains could probably explain why these investments, while positive, are not really undertaken in the reality without proper government incentives.

The economic consequences of climate change

OECD
BETTER POLICIES FOR BETTER LIVES

Climate change analysis

- Context: part of the CIRCLE project on costs of inaction
  - Other workstreams focus on air pollution and land-water-energy nexus
- Aim: assess the economic consequences of climate change
- Methodology:
  - Take existing impact estimates from literature
  - Calculate costs of environmental damages to the macro-economy and study how the economies adjust to the presence of environmental damages
  - Put into larger context of other major impacts of climate change

CIRCLE: **C**osts of **I**naction and **R**esource scarcity: **C**onsequences for **L**ong-term **E**conomic growth

Selected impacts of climate change

Included in the modelling

- Agriculture: yield changes for 8 crop sectors, and fisheries
- Coastal zones: capital and land losses due to sea level rise
- Health: diseases and labour productivity losses from heat stress
- Energy demand
- Tourism demand
- Capital damages from hurricanes

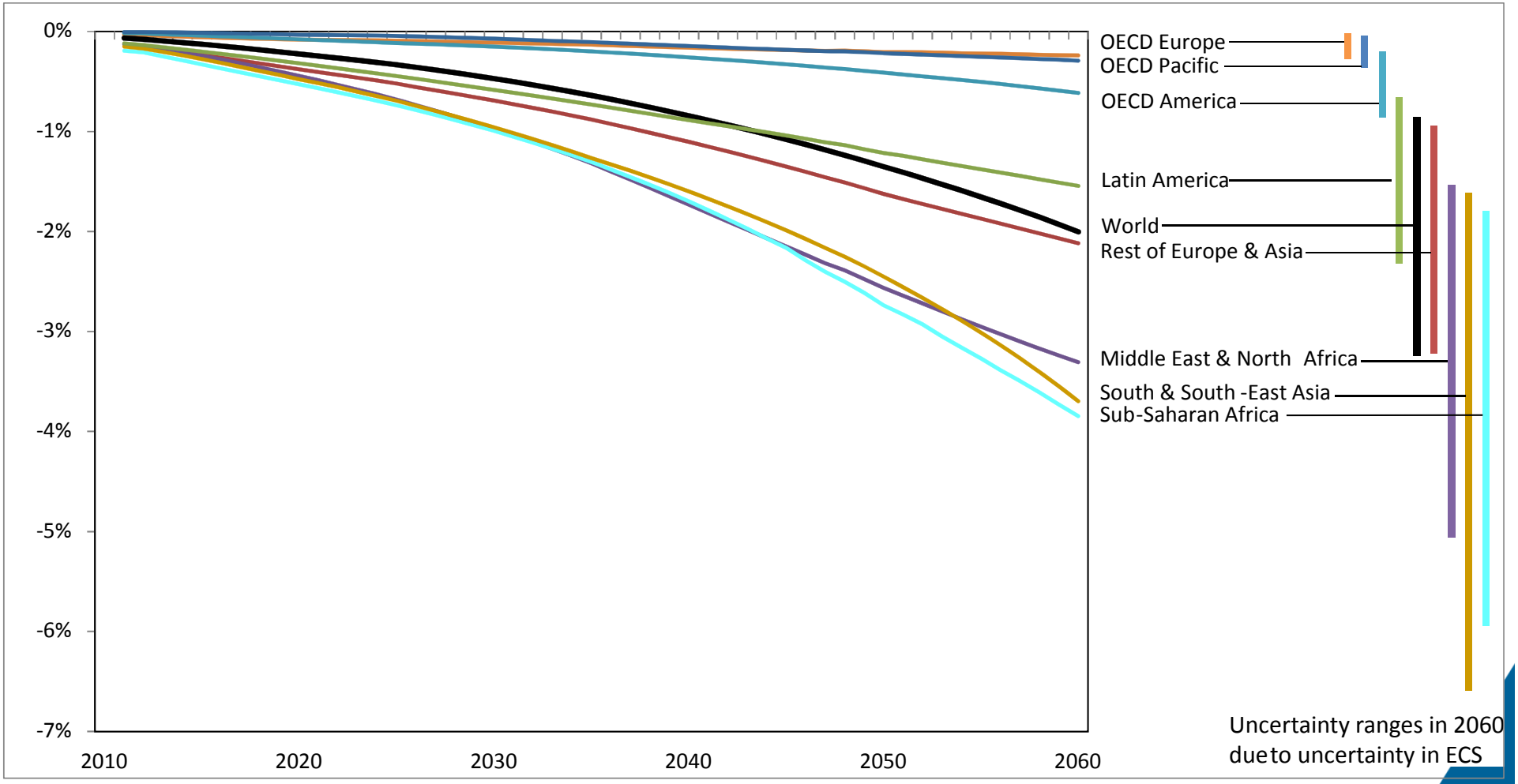
Stand-alone analysis

- Fatalities from heatwaves
- Urban damages from river floods
- Ecosystems: biodiversity (crude approximation)

Still not quantified

- Large-scale disruptive events, …

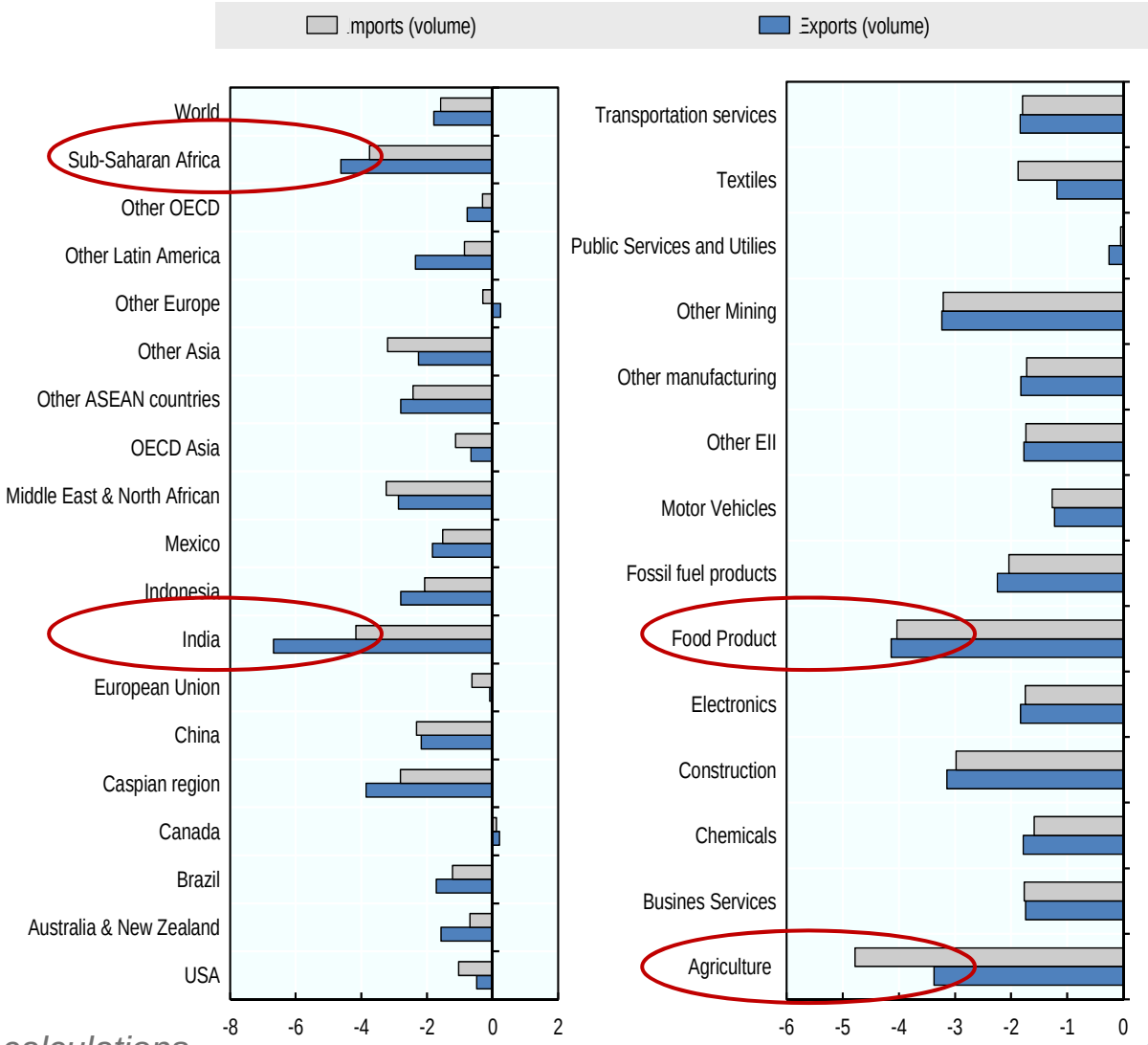
Regional cost of selected climate impacts



Source: ENV-Linkages calculations

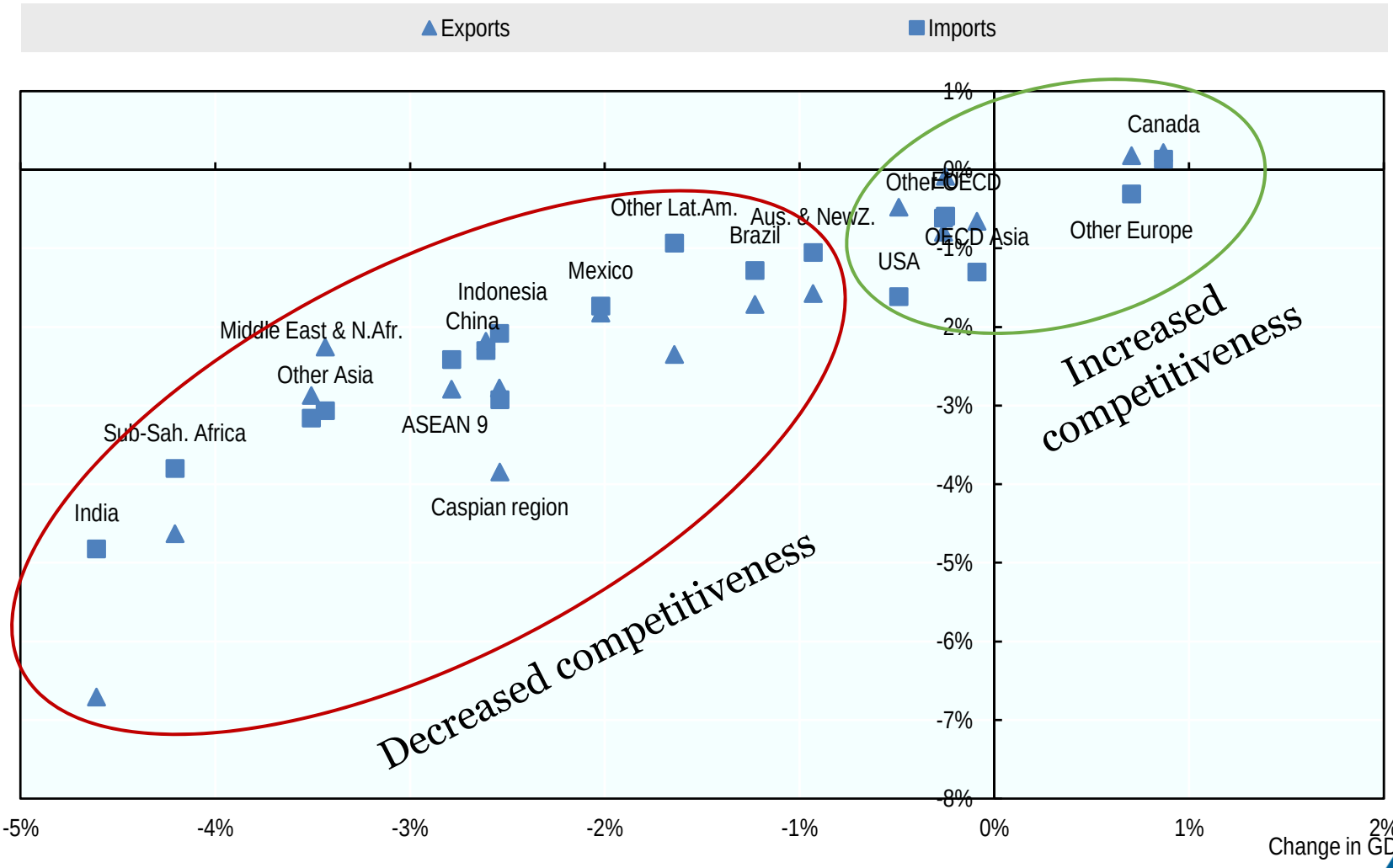
Change in imports and exports due to climate change impacts in 2060

- Generally less imports and exports
- Uneven regional effects across the world
- Agricultural and food products most affected



Source: ENV-Linkages calculations

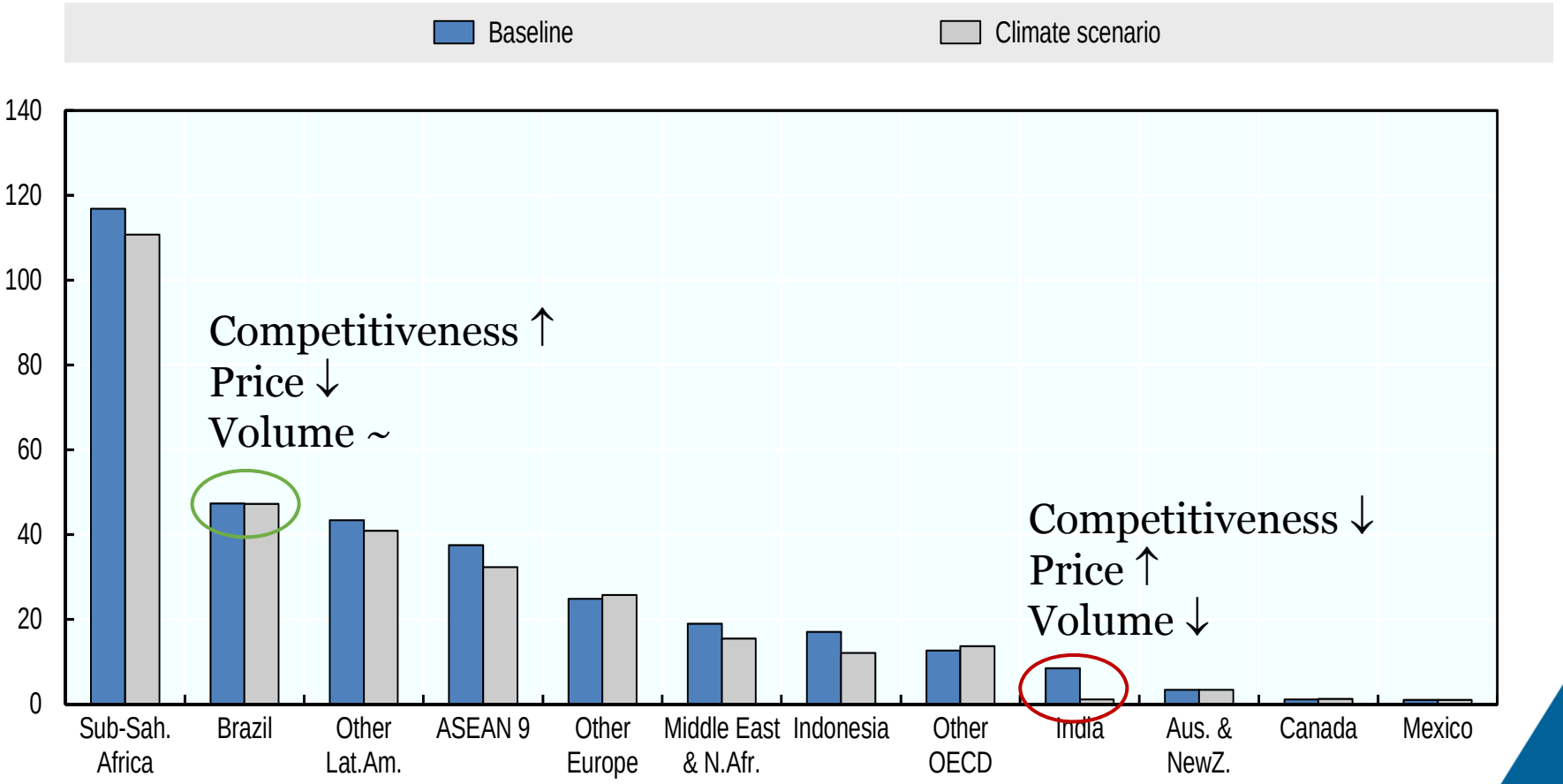
Changes in trade volumes in 2060



Source: ENV-Linkages calculations

Food exports to the EU in 2060

Volume of exports of food products to EU



Source: ENV-Linkages calculations

Final remarks

BETTER POLICIES FOR BETTER LIVES

The discussion questions (slightly edited)

a) Which models are suited to capture the key questions for long-term scenario analysis?

b) What features would need to be added or changed?

c) How are climate change and its impacts captured?

d) What questions could be dealt with outside the modelling framework?

e) Which aspects should be handled in a CGE setting and which through PE or kept exogenous?

f) How can “post-solve” calculations help?

g) Is a recursive-dynamic model good enough? If not, what would be the alternative?

THANK YOU!

For more information:

www.oecd.org/environment/CIRCLE.htm

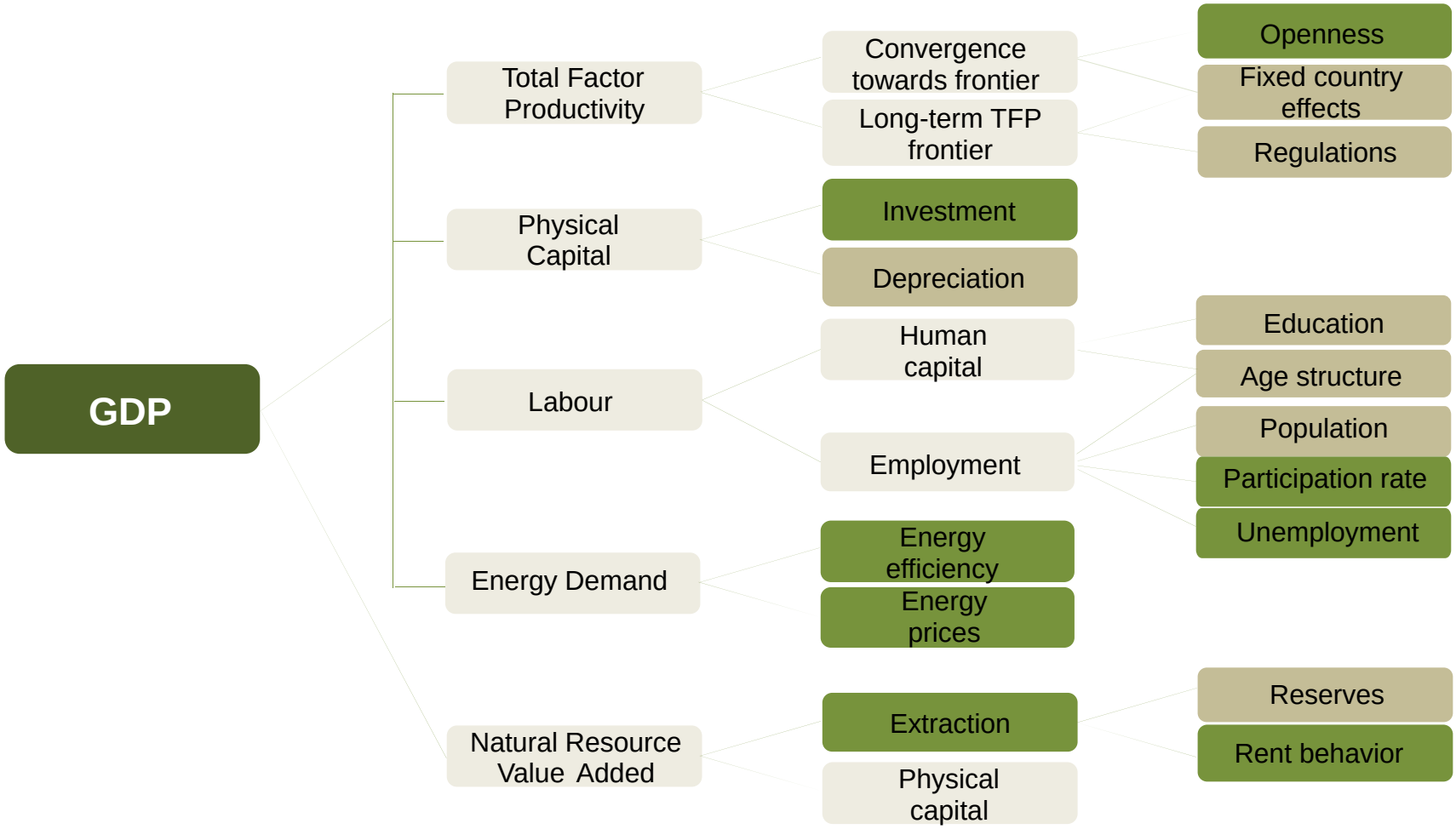
www.oecd.org/environment/modelling

rob.dellink@oecd.org

OECD

BETTER POLICIES FOR BETTER LIVES

Macroeconomic projections: the ENV-Growth model (180+ countries)



Env-Linkages regional aggregation for Circle

OECD regions

United States of America
Canada
Mexico

Chile

Japan

South Korea

Australia and New Zealand

OE5: Other OECD Europe (Iceland, Norway, Switzerland and Turkey and Israel)

EG4 (France, Germany, Italy and the United Kingdom.)

E17: Other OECD EU (Austria, Belgium, the Czech Republic, Denmark, Estonia, Finland, Greece, Hungary, Ireland, Luxembourg, Netherlands, Poland, Portugal, Slovak Republic, Slovenia , Spain, and Sw eden.)

Non-OECD Regions

Brazil
China
India

EU7: European Union Non OECD (Bulgaria, Croatia, Cyprus, Latvia, Lithuania, Malta, and Romania)

Russia

OEU: Non-EU Eastern Europe (Albania, Belarus, Bosnia and Herzegovina, Gibraltar, the Former Yugoslav Republic of Macedonia, the Republic of Moldova, Serbia and Ukraine)

Middle-East (Bahrain, the Islamic Republic of Iran, Iraq, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, the United Arab Emirates and Yemen)

Indonesia

ASEAN9: Other ASEAN countries (Brunei Darussalam, Cambodia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam)

ODA: Other Developing Asia (Bangladesh, Chinese Taipei, the Democratic People's Republic of Korea, Mongolia, Nepal, Pakistan, Sri Lanka and other non-OECD Asian countries)

Caspian (Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan)

North-African (Algeria, Egypt, Libya, Morocco and Tunisia)
South Africa

OAF: Other African Countries (Angola, Benin, Botswana, Cameroon, Congo, Democratic Republic of Congo, Côte d'Ivoire, Eritrea, Ethiopia, Gabon, Ghana, Kenya, Mozambique, Namibia, Nigeria, Senegal, South Sudan, Sudan, United Republic of Tanzania, Togo, Zambia, Zimbabwe and other African countries)

OLA: Other Latin America (Argentina, Bolivia, Colombia, Costa Rica, Cuba, the Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Jamaica, Netherlands Antilles, Nicaragua, Panama, Paraguay, Peru, Trinidad and Tobago, Uruguay, Venezuela and other Latin American countries)

Env-Linkages sectoral aggregation for Circle:

Agriculture
- Paddy Rice
- Wheat and meslin
- Other Grains
- Vegetables and fruits
- Sugar cane and sugar beet
- Oil Seeds
- Plant Fibres
- Other Crops
- Livestock
- Forestry
- Fisheries

Natural Resources and Energy
- Coal
- Crude Oil
- Gas extraction and distribution
- Other mining
- Petroleum and coal products
- Electricity (7 technologies#)

Manufacturing
- Paper and paper products
- Chemicals
- Non-metallic minerals
- Iron and Steel
- Metals n.e.s.
- Fabricated metal products
- Food Products
- Other manufacturing
- Motor vehicles
- Electronic Equipment
- Textiles

Services
- Land Transport
- Air and Water Transport
- Construction
- Trade Other Services and Dwellings
- Other Services (Government)

Fossil-Fuel based Electricity ; Combustibe renew able and w aste based Electricity ; Nuclear Electricity; Hydro and Geothermal ; Solar and Wind ; Coal Electricity w ith CCS ; Gas Electricity w ith CCS

Linking economy and environment