

COALMOD World

Global Coal-Phase-Out and the International Coal Market: A Focus on Demand-side Policies in India

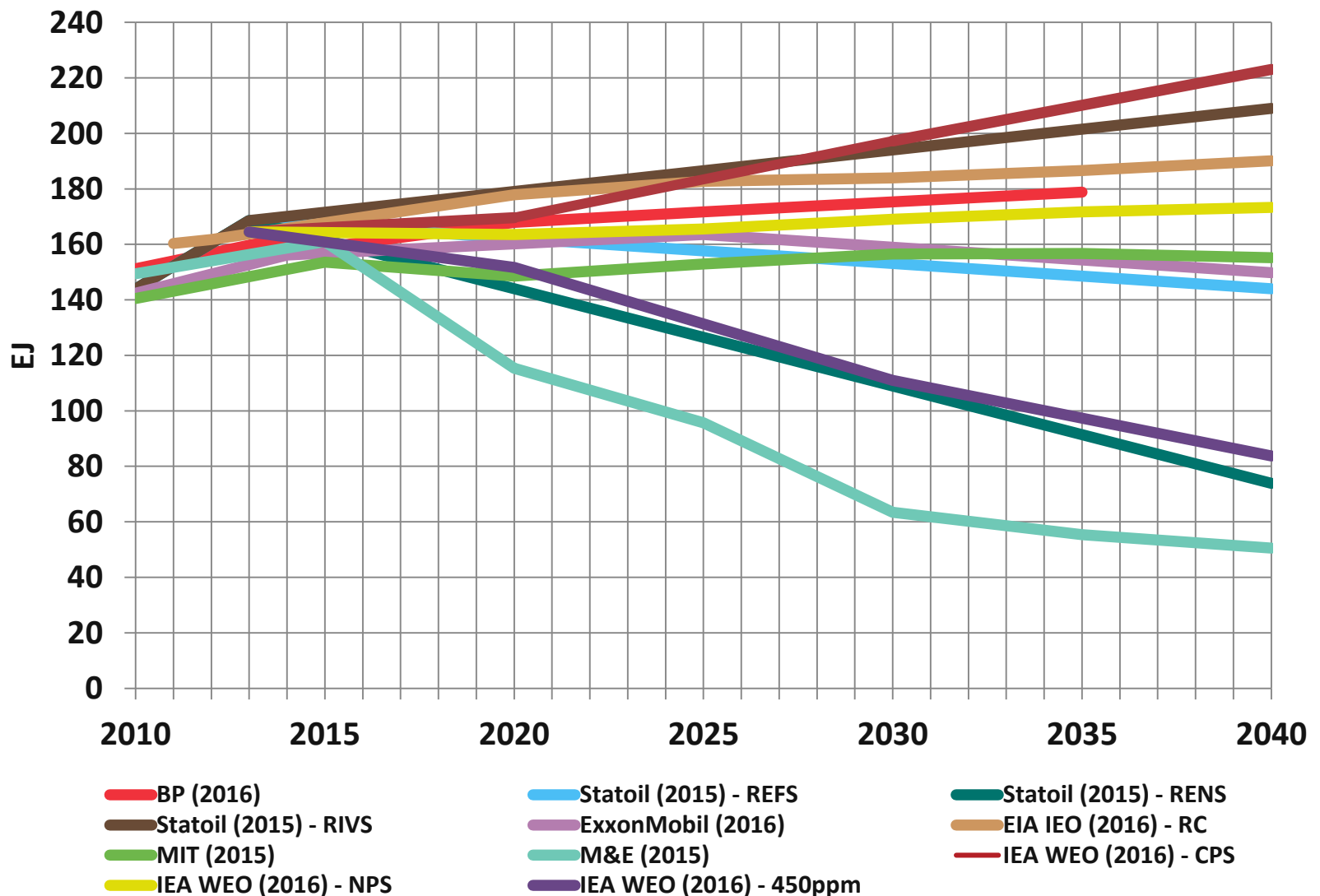
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Agenda

1. Global Coal Perspectives
2. Coal in India
3. Reference Scenarios
4. Model Structure
5. Results
6. Conclusion

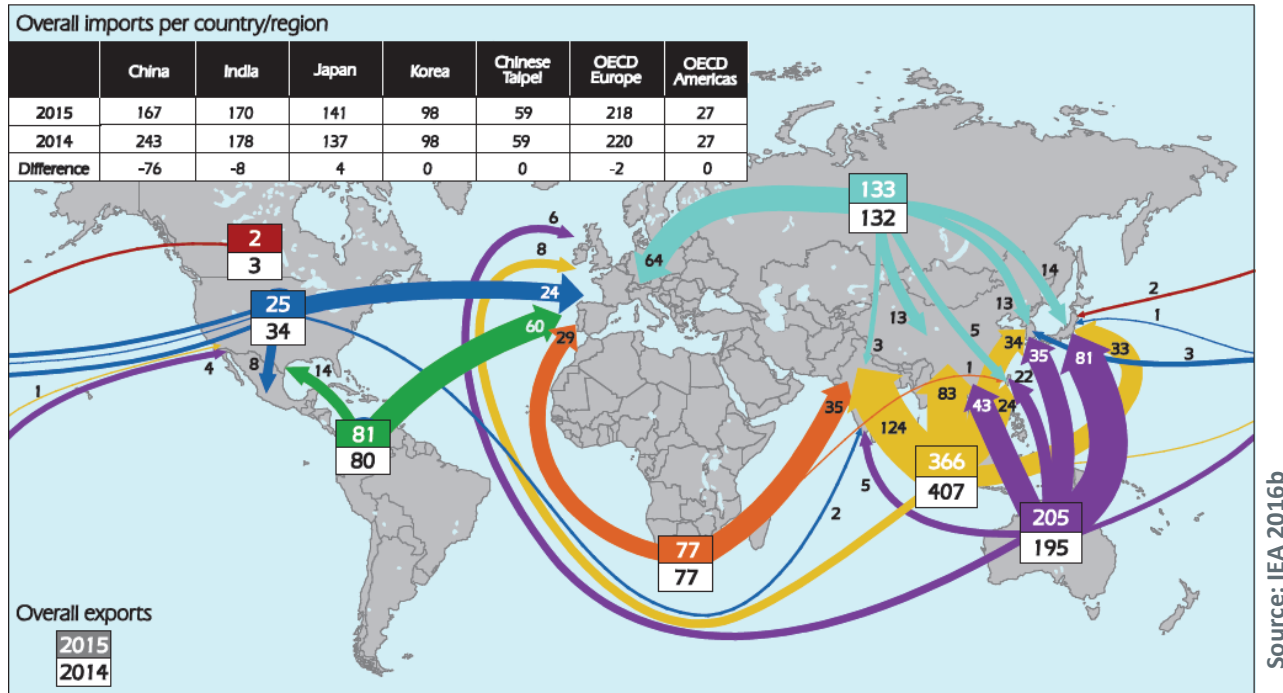
Global Coal Perspectives – Scenarios of Coal Consumption



Source: Mendelevitch et al. 2016; based on BP (2016), EIA (2016a), ExxonMobil (2016), IEA (2016), McGlade and Ekins (2015a), MIT (2015), and Statoil (2016).

- Spread of projections illustrates **uncertainty** about future coal consumption
- Major **drivers for differences** in scenarios:
 - Potential of renewable energy sources and storage
 - structural changes in the energy system (e.g. higher electricity demand due to sector coupling)
 - CCTS employment
 - Macro-economic trends and total energy demand
 - Policy measures (e.g. carbon price)

1 Global Coal Perspectives – The Global Steam Coal Market



Overview of world steam coal market: supply, demand, trade

Major producers in 2014

China (3,200 Mt)
 United States (770 Mt)
 India (560 Mt)
 Indonesia (470 Mt)

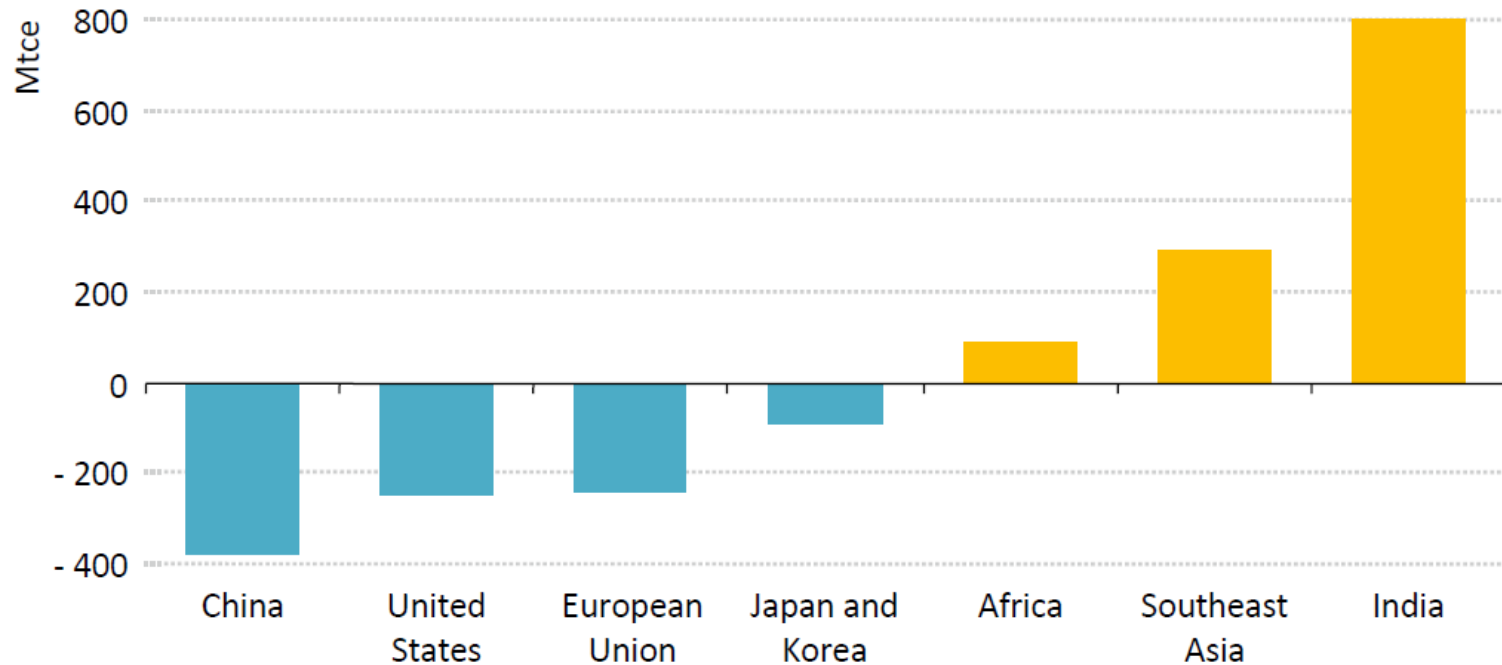
World production 6,150 Mt

Major consumers in 2014

China (3,280 Mt)
 India (760 Mt)
 United States (750 Mt)

World consumption 6,090 Mt

Source: IEA 2016b.



Source: IEA/OECD (2016), p. 212.

- Climate pledges by EU, US and China result in coal demand decrease
- Increasing coal demand mainly in India and Southeast Asia

- Coal **consumption** in power generation: **81 %**
- installed **capacity** of steam coal power plants: **176 GW** → 60% of total capacity
- Steam coal **consumption** 2015: **753 Mt**
- Steam coal **production** 2015: **585 Mt**
- Imports by power utilities: 22 % of their total coal consumption
- thermal coal **imports** 2015: **168 Mt**
- main **exporters**
 - Indonesia (125 Mt)
 - South Africa (35 Mt)
 - Australia (8 Mt)
 - Russia (3 Mt)
 - United States (2 Mt)

Sources: Cornot-Gandolphe (2016), IEA/OECD (2016), IEA/OECD (2016b).

- „ [...], it is more than ever **environmental policies** that determine the evolution of regional coal demand.” (IEA (2016), p. 212)
- Specific policies also affect international steam coal trade

Policy objective	Measures
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Expansion of RES	<ul style="list-style-type: none">• New RES policy: Capacity expansion solar, wind

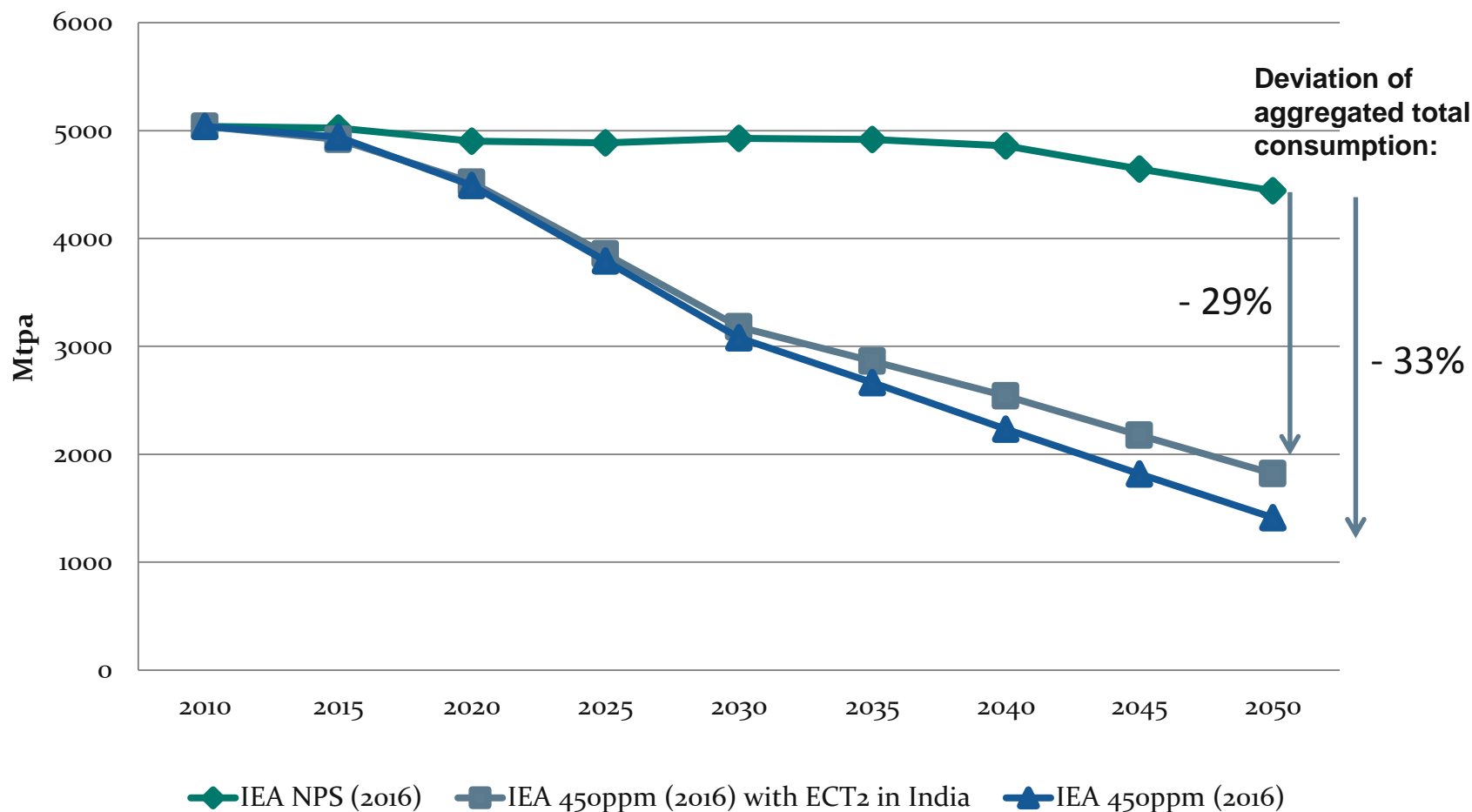
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Coal self-sufficiency	<ul style="list-style-type: none">• Higher domestic production (target 1500 Mt)

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Reduction of air pollution:	<ul style="list-style-type: none"> • Burning coal with lower ash content • Washing

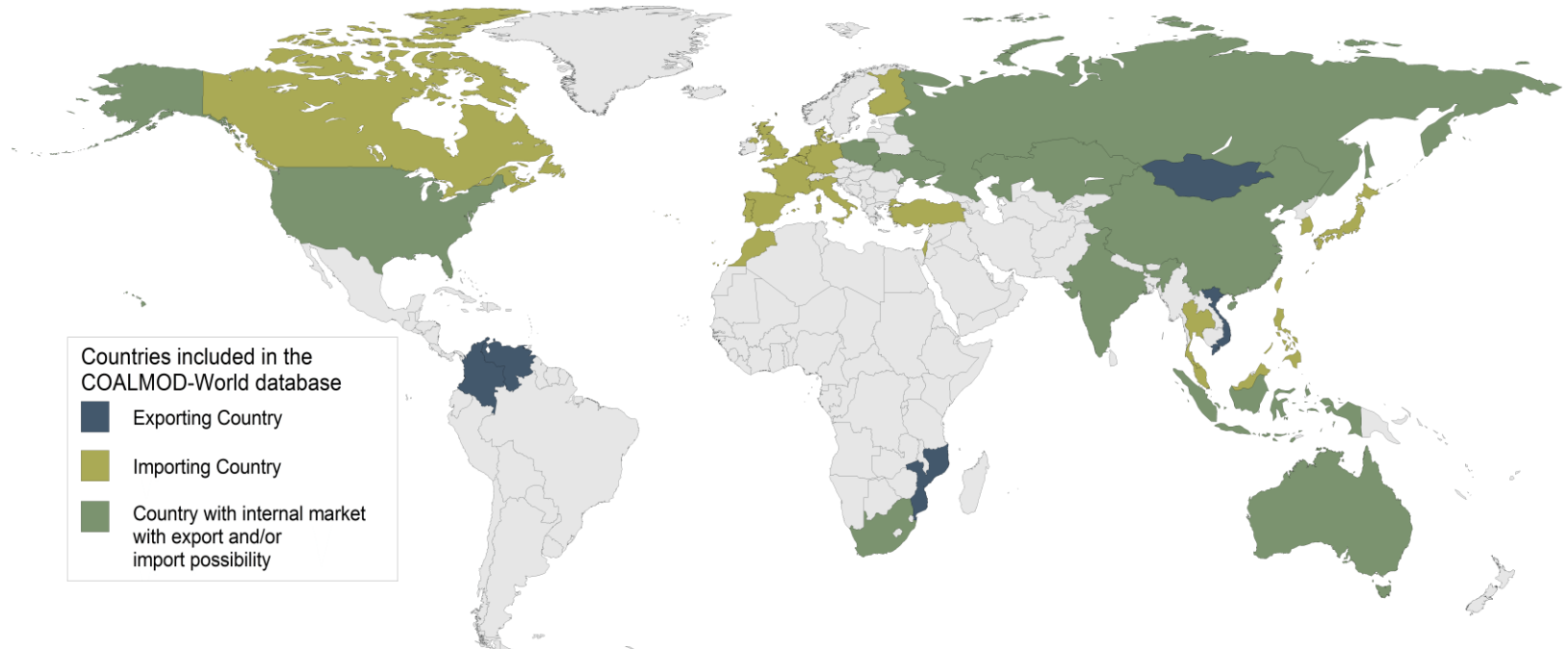
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Efficiency increase	<ul style="list-style-type: none"> • Plants based on supercritical technology

Policy objective	Measures	Considered in Scenarios by
Expansion of RES	<ul style="list-style-type: none"> • New RES policy: Capacity expansion solar, wind 	<ul style="list-style-type: none"> • Different reference coal demand based on: • IEA NPS, IEA 450, ECT₂
Coal self-sufficiency	<ul style="list-style-type: none"> • Higher domestic production (target 1500 Mt) 	<ul style="list-style-type: none"> • Import tax • Import restriction • Minimum required imports of 65 Mt
Reduction of air pollution:	<ul style="list-style-type: none"> • Burning coal with lower ash content • Washing 	<ul style="list-style-type: none"> • Not considered
Efficiency increase	<ul style="list-style-type: none"> • Plants based on supercritical technology 	<ul style="list-style-type: none"> • Quality Standard for imported coal • Minimum required imports of 65 Mt

Global Coal Consumption by Scenario



Represented countries by type:



Source: Adapted from Holz et al. 2016

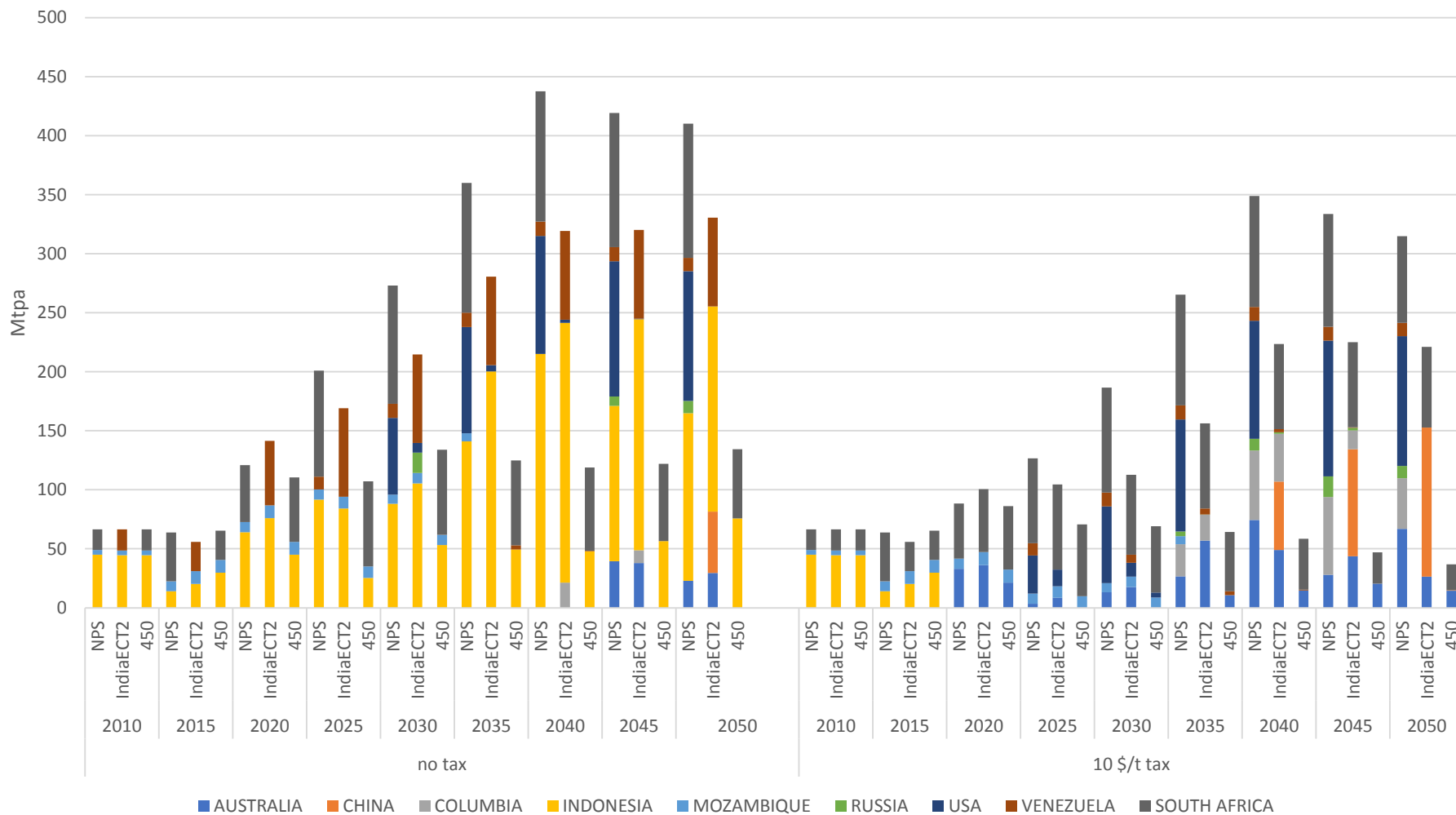
- 40 consumption nodes (C), 25 producers (P), and 14 exporters (E)
- Multi-period model with yearly equilibria in 5-years-steps from 2010 to 2050
- Demand in energy services from coal vs. cost in \$/t makes the cost-efficient equilibrium solution non-obvious

Results

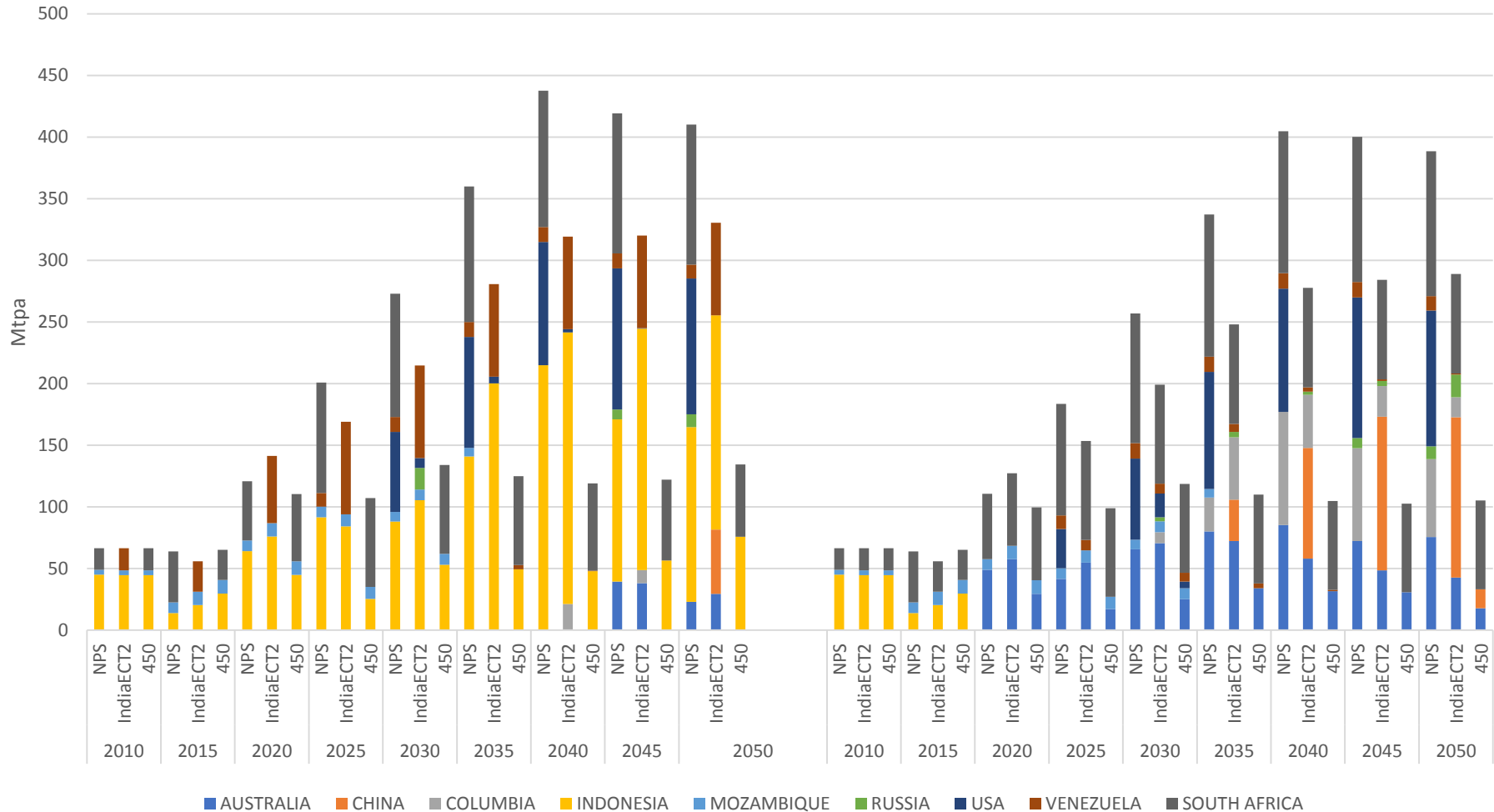
Results – Scenario Overview

	NPS	450ppm	450ppm but India ECT ₂
Import Tax			
Quality Standard			
Import restriction			

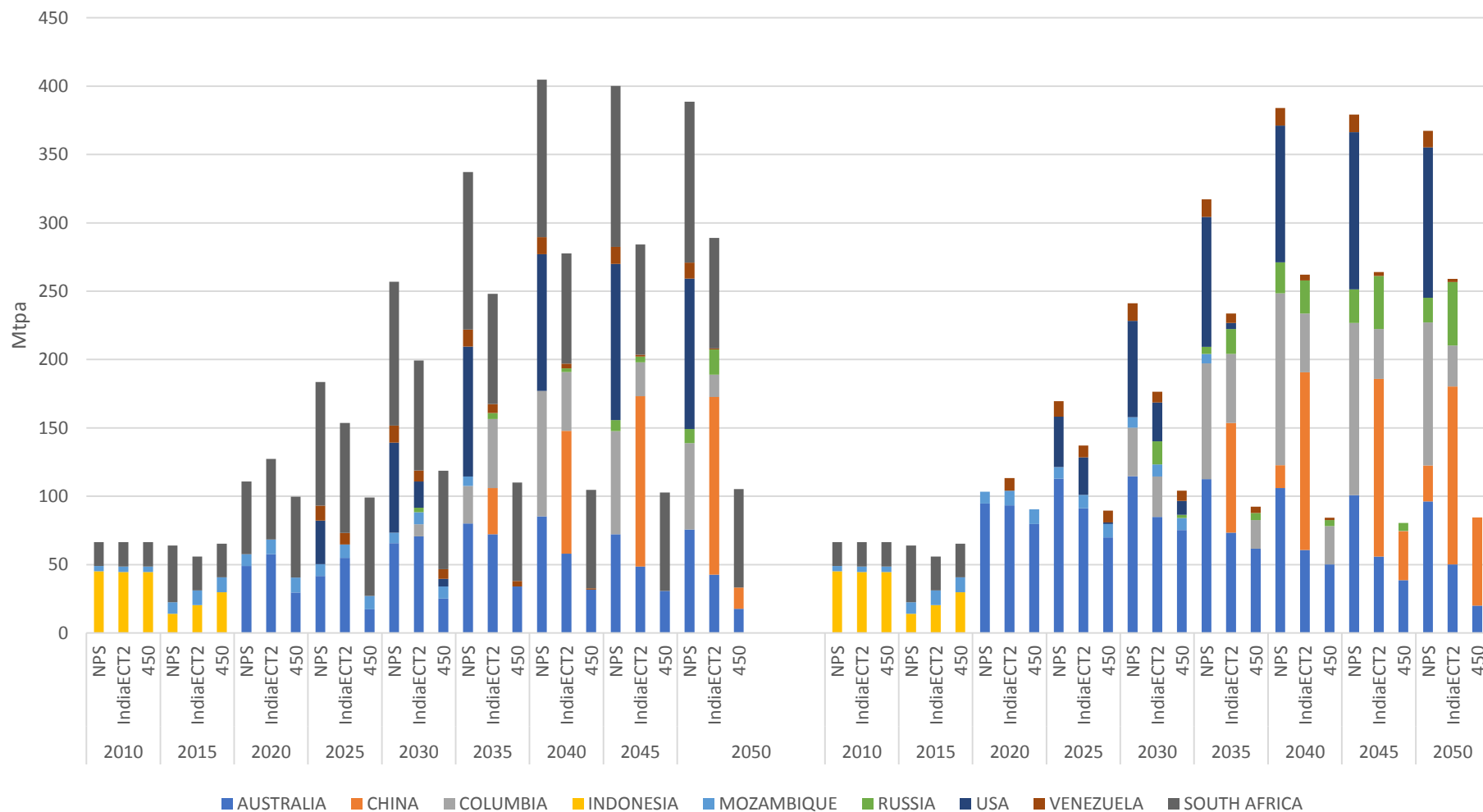
Indian Imports: Reference Scenario vs. Import Tax (10 \$/t)



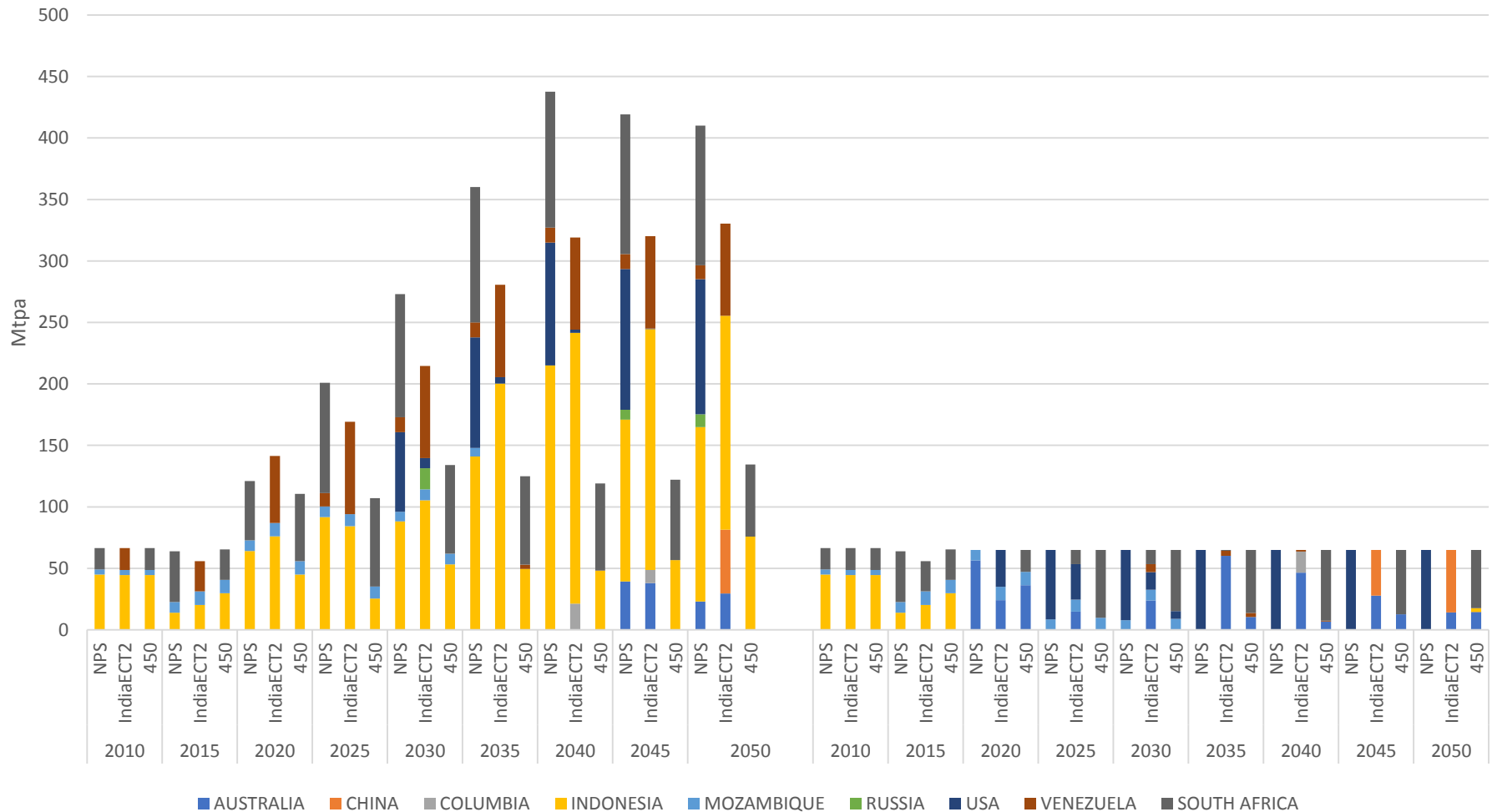
Indian Imports: Reference Case vs. Quality Standard (Calorific value of 22.9 GJ/t)



Indian Imports: Different Quality Standards (Minimum Calorific Value of 22.9 GJ/t vs. 23.1 GJ/t)



Indian Imports: Reference Scenario vs. Import Restriction (65 Mt)



- NPS: Import dependency due to domestic bottlenecks and rapidly increasing demand
- ECT2 and 450: less import dependency due to lower demand

Policies:

- **Tax:** decreasing imports; increasing domestic production; trend continues with an increasing tax
- **Quality Standard:** does not reduce imports → only different exporters dependent on quality standard
- **Import Restriction:** domestic production increases by ~ 100 Mt (NPS) and ~ 50 Mt (India ECT2 and 450 ppm)

- **Tax:** Loss of market share in India is compensated by increasing exports to China
- **Import restriction:** loss of market share in India is compensated by increasing exports to China
- **Quality standard:** loss of market share in India is compensated by increasing exports to China, Taiwan and Philipines

- **Tax:**

low tax: Exports decrease slightly (20 Mt)

higher tax: loss of market share in India compensated by Malaysia, Thailand and China

- **Import restriction:**

- In NPS: high decrease of exports → 50 % less exports ~ 60 Mt; losses partly compensated by China, Thailand and Malaysia

- ECT2 India and 450: slight decrease of exports

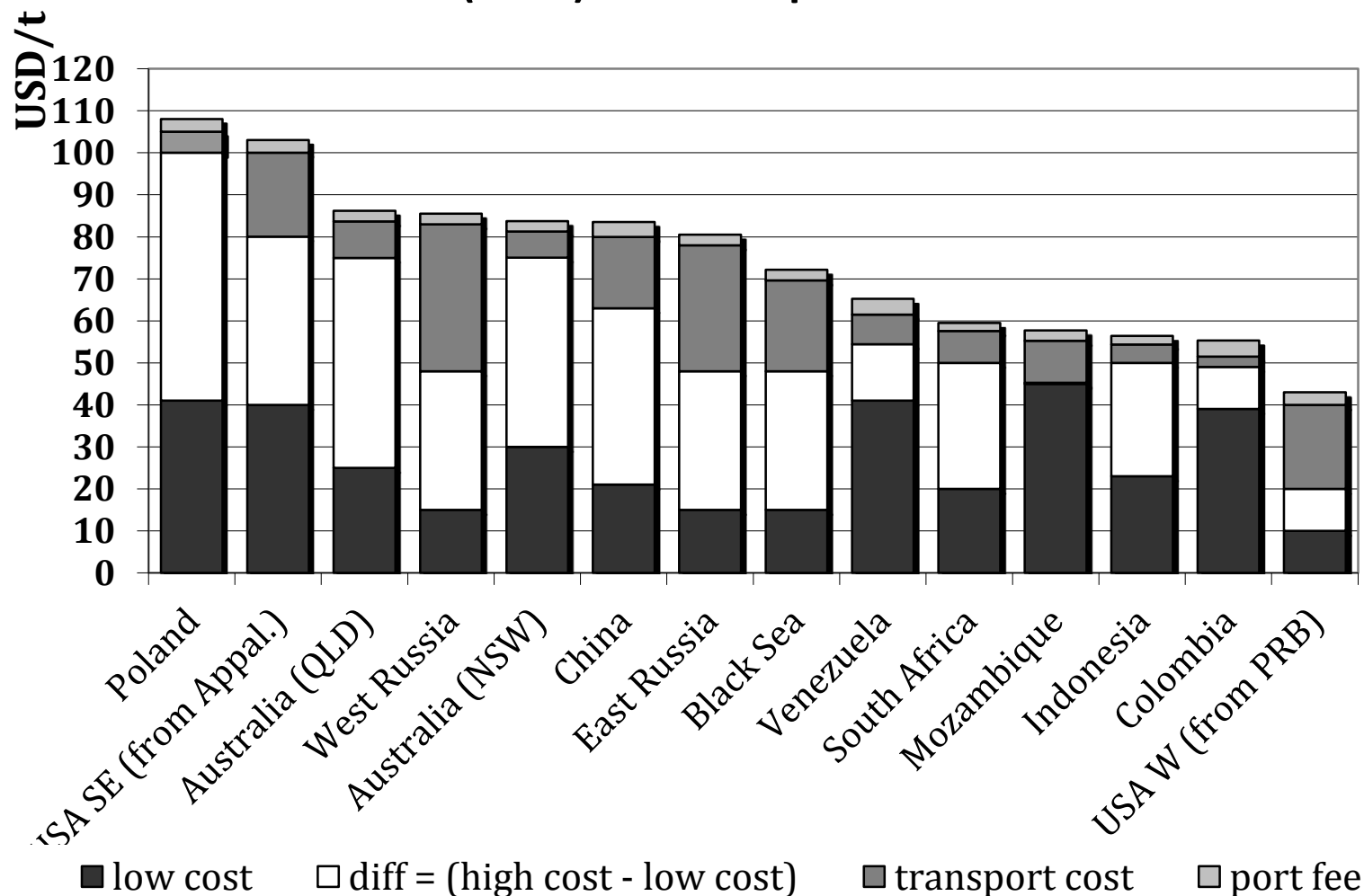
- **Quality standard:** if $cv > 23$ → India market is lost, compensated by China, Malaysia, Thailand and Latin American Countries



Thank you

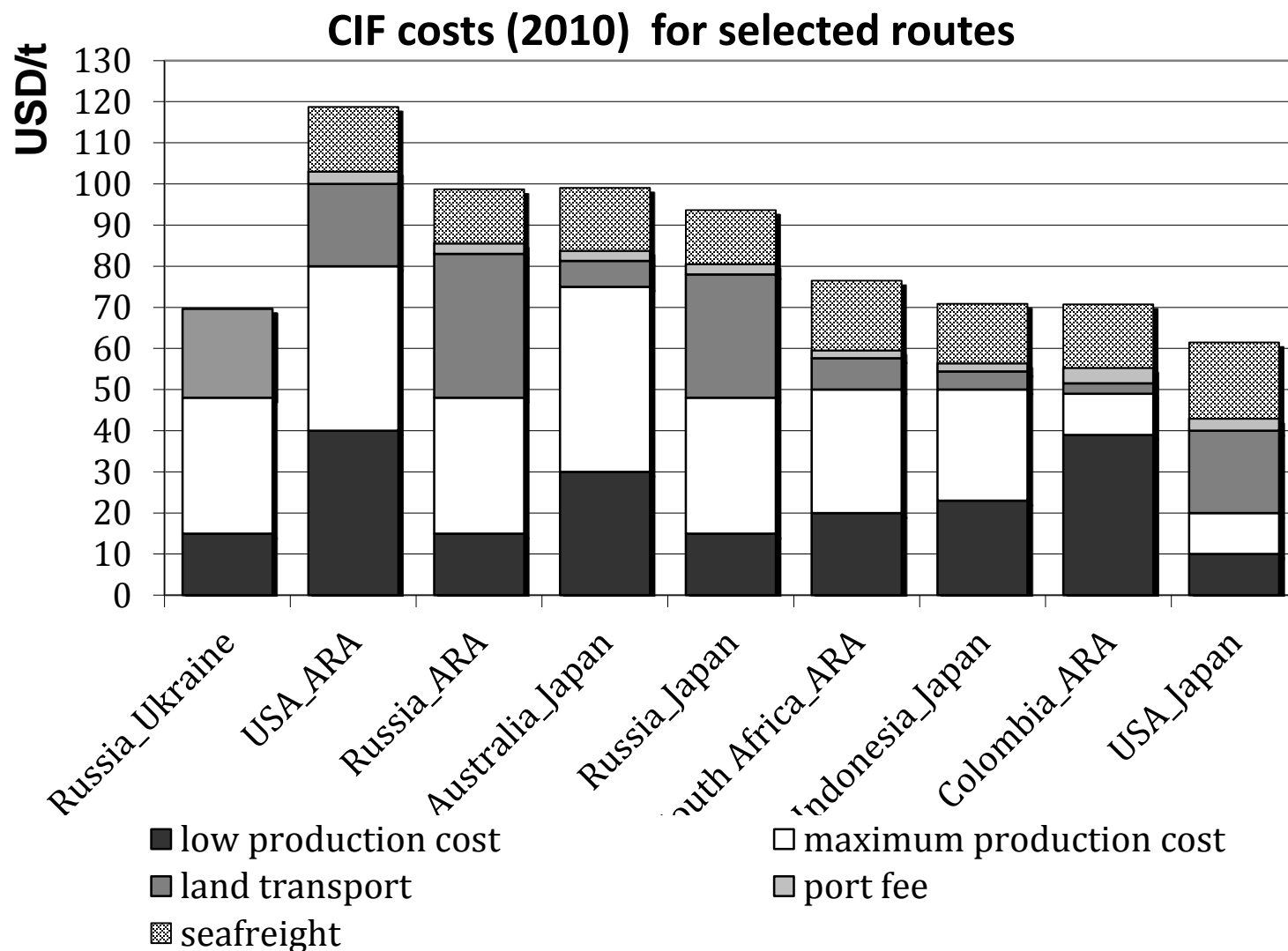
COALMOD Results: Analysis of Key Drivers

FOB costs (2010) for the export countries



Source: Mendelevitch et al. (2016) bases on Baruya (2007).

COALMOD Results: Analysis of Key Drivers



Source: Mendelevitch et al. (2016).

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