MIDDLE EAST CENTER FOR ECONOMICS AND FINANCE

A Low-Carbon Future for the Middle East and Central Asia: What are the Options
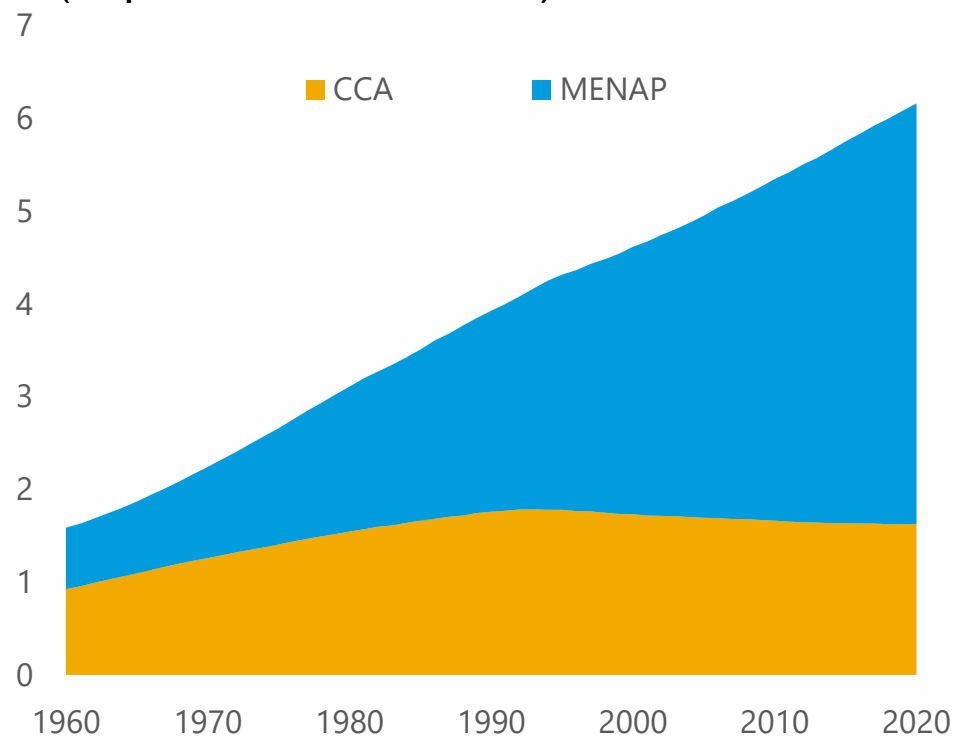
NOVEMBER 6, 2023
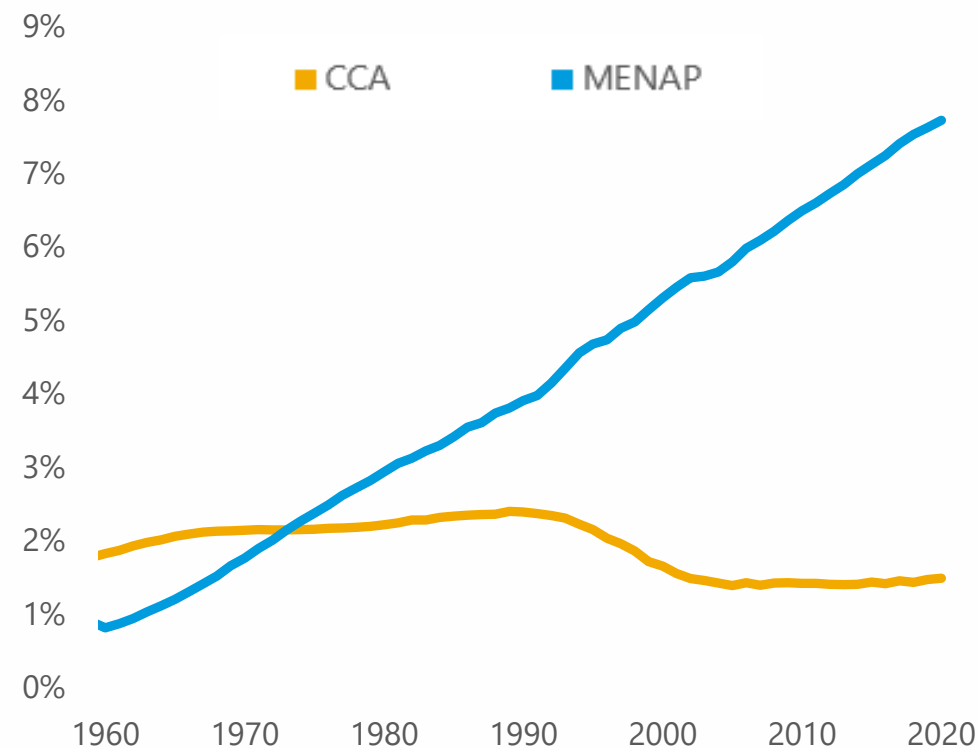
Gareth Anderson and Ling Zhu

Outline

- Recent Trends in GHG Emissions in ME&CA

- Climate Mitigation Pledges

- Policy Options and Trade-offs

Greenhouse Gas Emissions in the ME&CA Region

Shares in Global CO2 Emissions: 1960-2020
(In percent, cumulative)

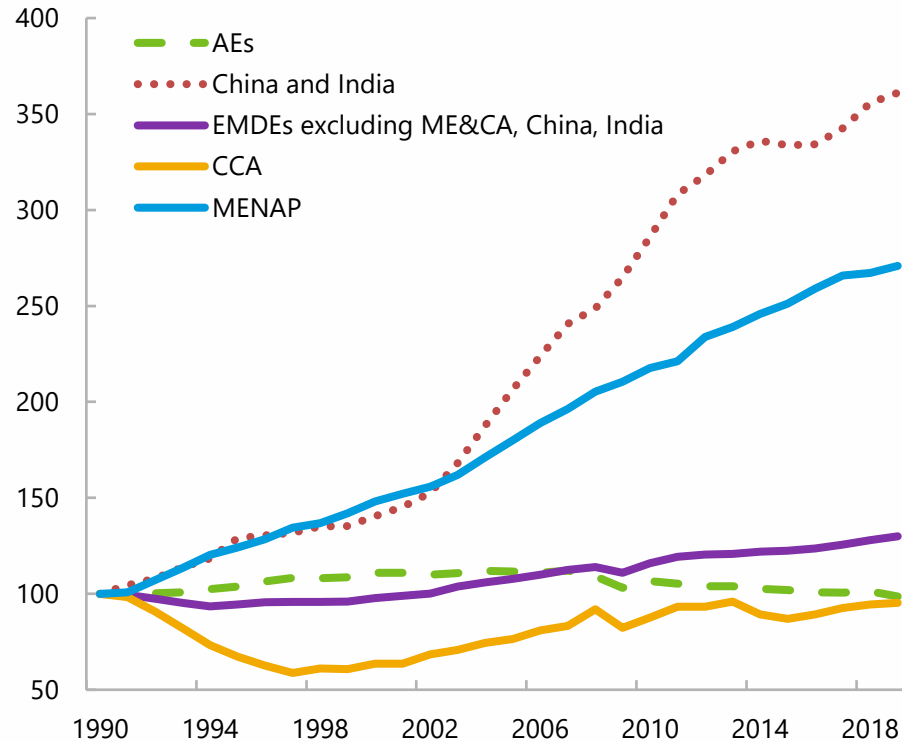**Share in Annual Global CO2 Emissions**
(In percent)

Sources: Climate Watch Database for the GHG emissions, IMF staff calculations.
Notes: GHG emissions exclude land use, land-use change, and forestry (LULUCF). AEs = Advanced Economies; EMDEs = Emerging and Developing Economies; ME&CA = Middle East, North Africa, and Central Asia. GHG emissions exclude land use, land-use change, and forestry (LULUCF).

Greenhouse Gas Emissions in the ME&CA Region

GHG Emissions
(Index, 1990 = 100)

Legend:
- AEs
- China and India
- EMDEs excluding ME&CA, China, India
- CCA
- MENAP

Contribution to ME&CA's GHG Emissions, 2019
(Percentage of total)

Pie chart:
- IRN 18%
- SAU 15%
- PAK 9%
- EGY 7%
- KAZ 5%
- Other 46%

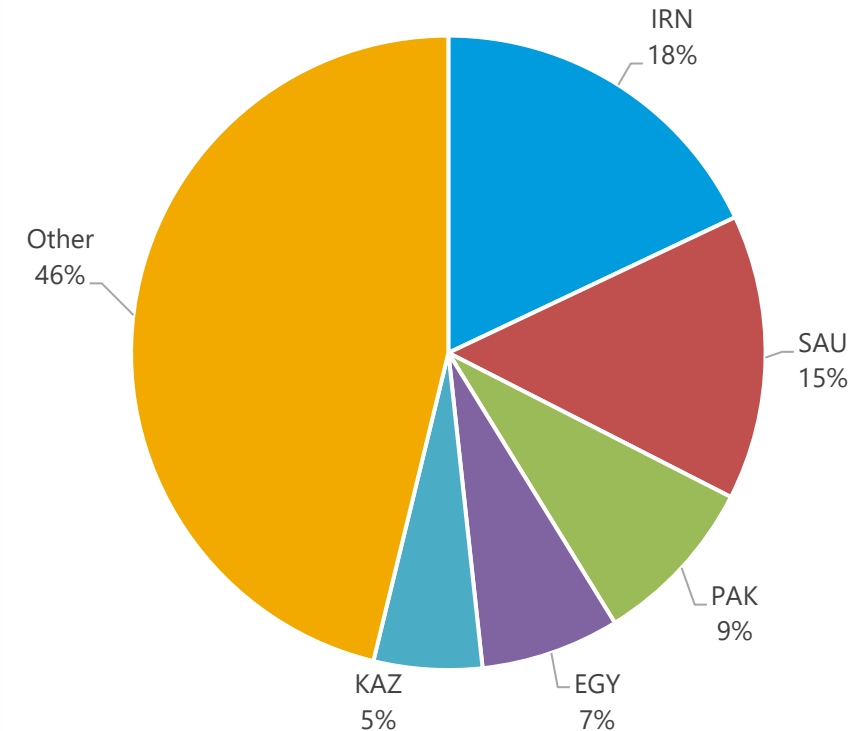Sources: Climate Watch Database for the GHG emissions, IMF staff calculations.
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Growth of Total GHG Emissions and Per Capita Emissions in ME&CA

Growth of GHG Emissions in ME&CA: 2000-19
(In percent)
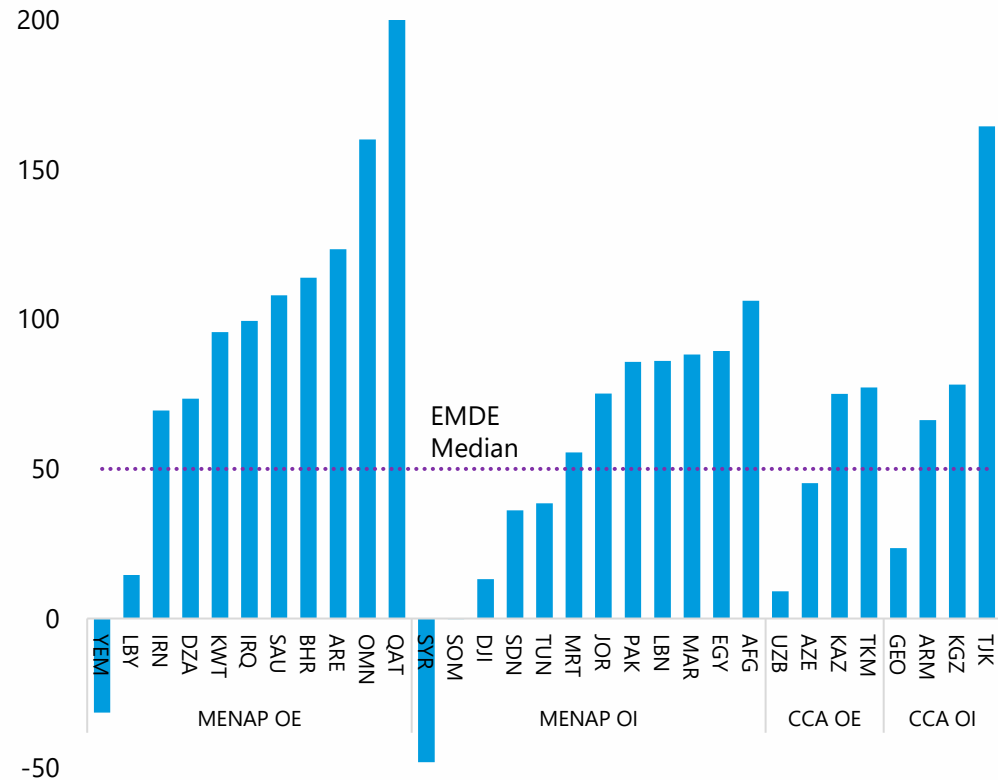
GHG Emissions per capita in ME&CA: 2019
(In multiples of EMDE median)
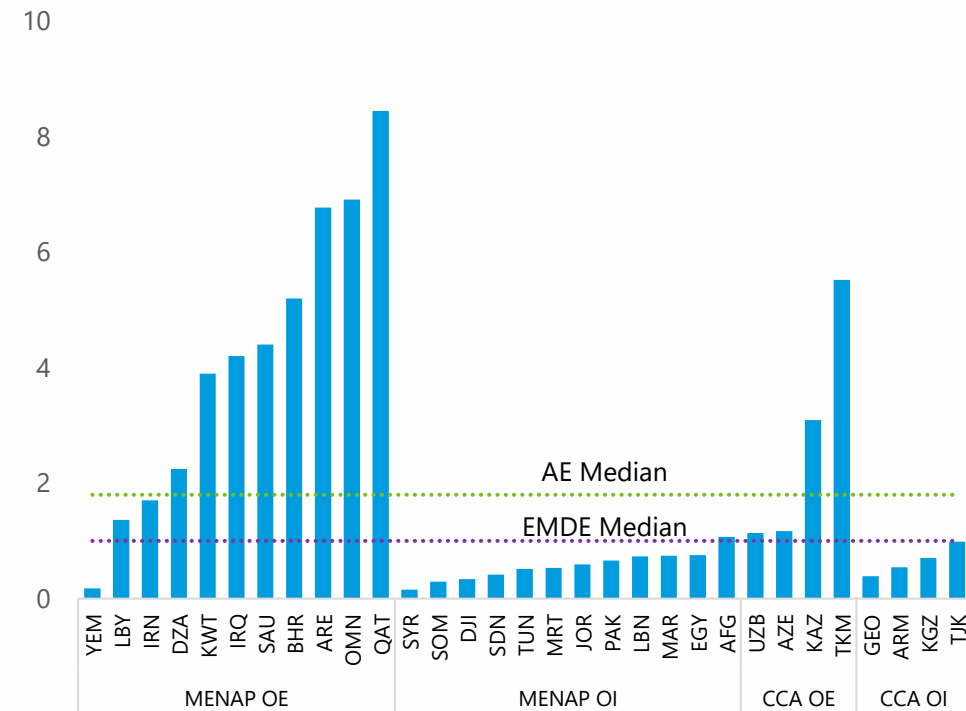
Kaya Decomposition in the ME&CA Region, 2000-19

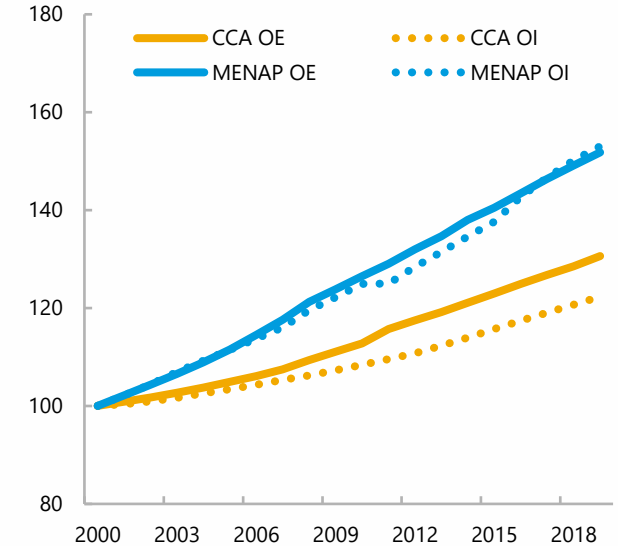$$GHG\ Emissions =$$

$$Population \times \frac{Real\ GDP}{Population} \times$$

$$\frac{Energy\ Consumption}{Real\ GDP} \times$$

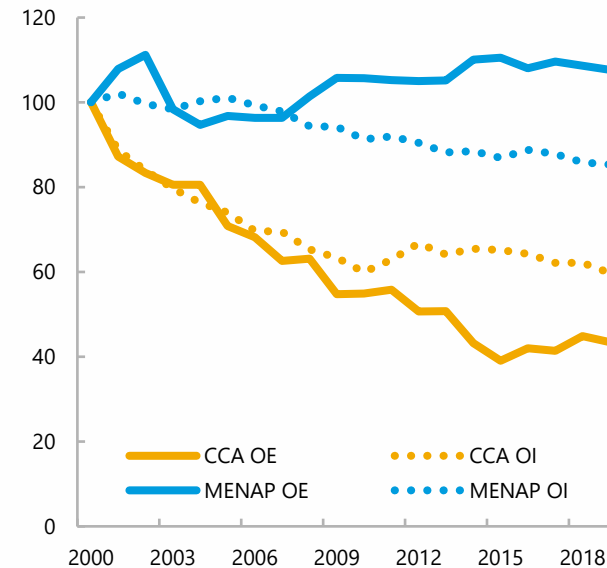$$\frac{GHG\ Emissions}{Energy\ Consumption}$$

GDP per capita
(Index, 2000 = 100)
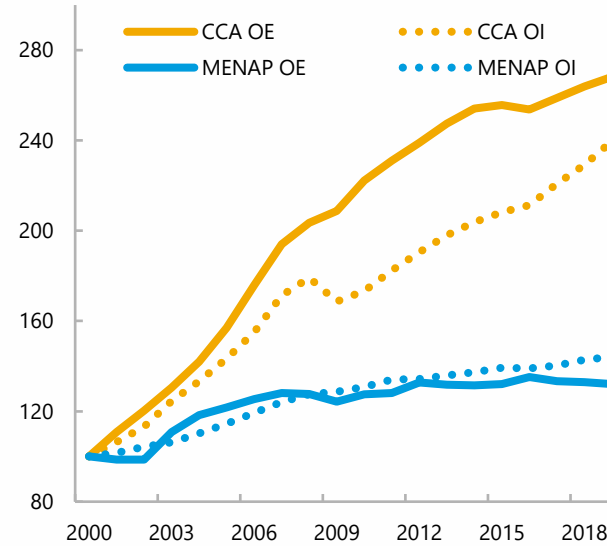
Population
(Index, 2000 = 100)

Energy Intensity
(Index, 2000 = 100)

Emission Intensity
(Index, 2000 = 100)

Legend (all charts): CCA OE, CCA OI, MENAP OE, MENAP OI
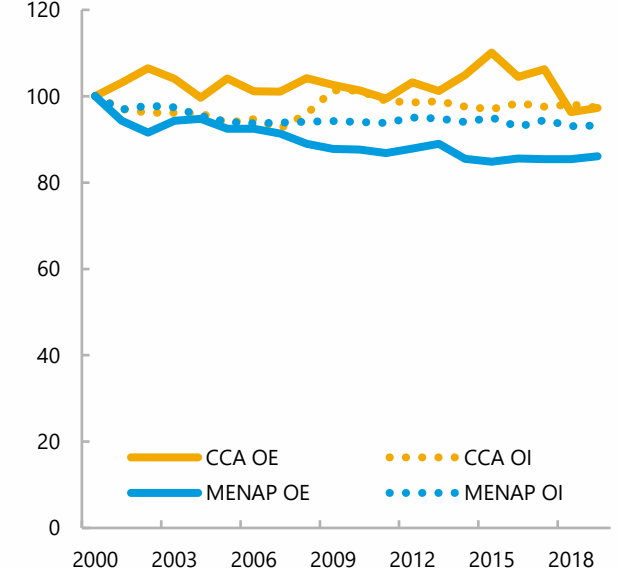
ME&CA's Climate Mitigation Pledges

NDC

31 MCD countries have published an NDC (Libya doesn't have an NDC yet)

Quantifiable targets

29 countries have quantifiable mitigation targets

2 without (i.e. Sudan, Syria)

Conditionality

6 countries with only conditional targets

7 with only unconditional targets

16 with both

Mitigation Benchmark

5 in percentage reduction from a historical baseline (i.e. 1990)

2 in percentage reduction in emission intensity

21 in percentage reduction from BAU level (with 2 fixed amount reduction from BAU)

2 no targets

Notes: NDC stands for nationally determined contribution. BAU stands for business-as-usual scenario.

Emissions Reduction Targets in MENAP

MENAP

(Metric-ton CO2-equivalent)
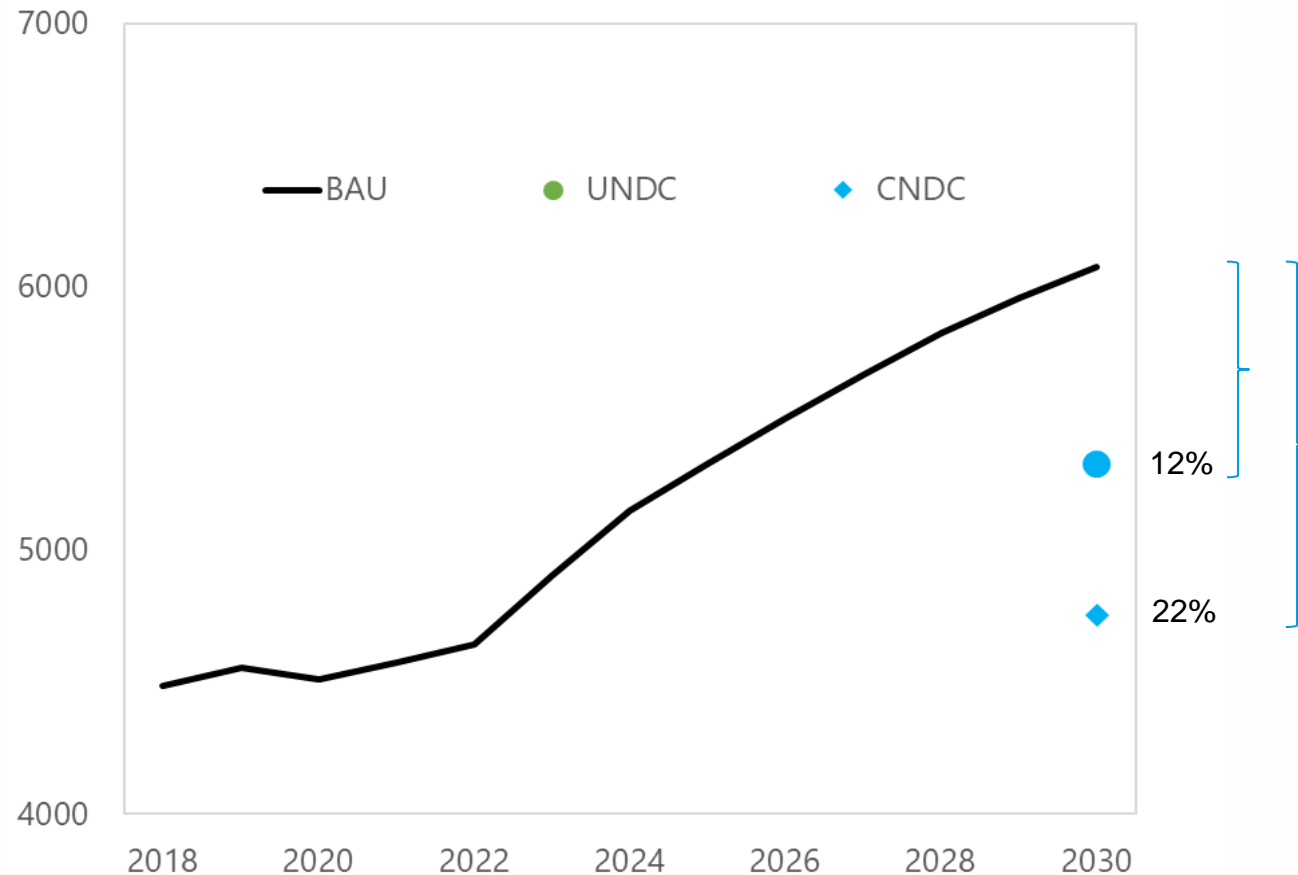
- IPCC: worldwide GHG emissions need to halve by 2030 for net emissions to reach zero by mid-century

Notes: UNDC stands for unconditional NDC mitigation targets; CNDC stands for conditional NDC mitigation targets.

Per capita emission will have to decrease by 7 percent for the region to achieve CNDC

Conditional NDCs: Required changes in per-capita emissions by 2030
(In percent, relative to the 2022 levels)

Globally, only a dozen countries were able to cut per capita emissions by 25 percent or more over the same period
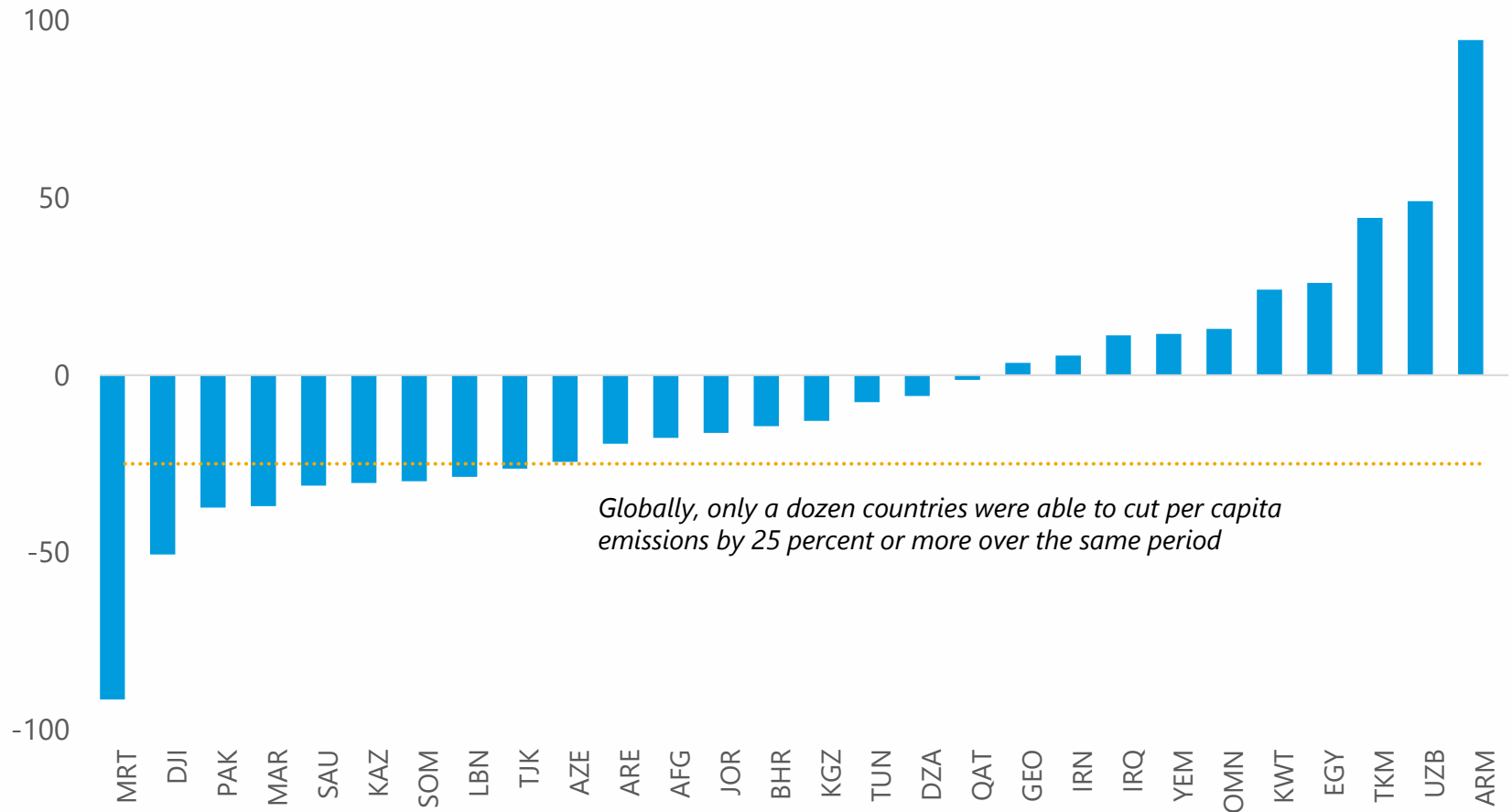
Mitigation Policy Options

ECR	Public Renewable Investment	FISCAL
Private Green Investment	Regulations (emission standards,etc.)	OTHER
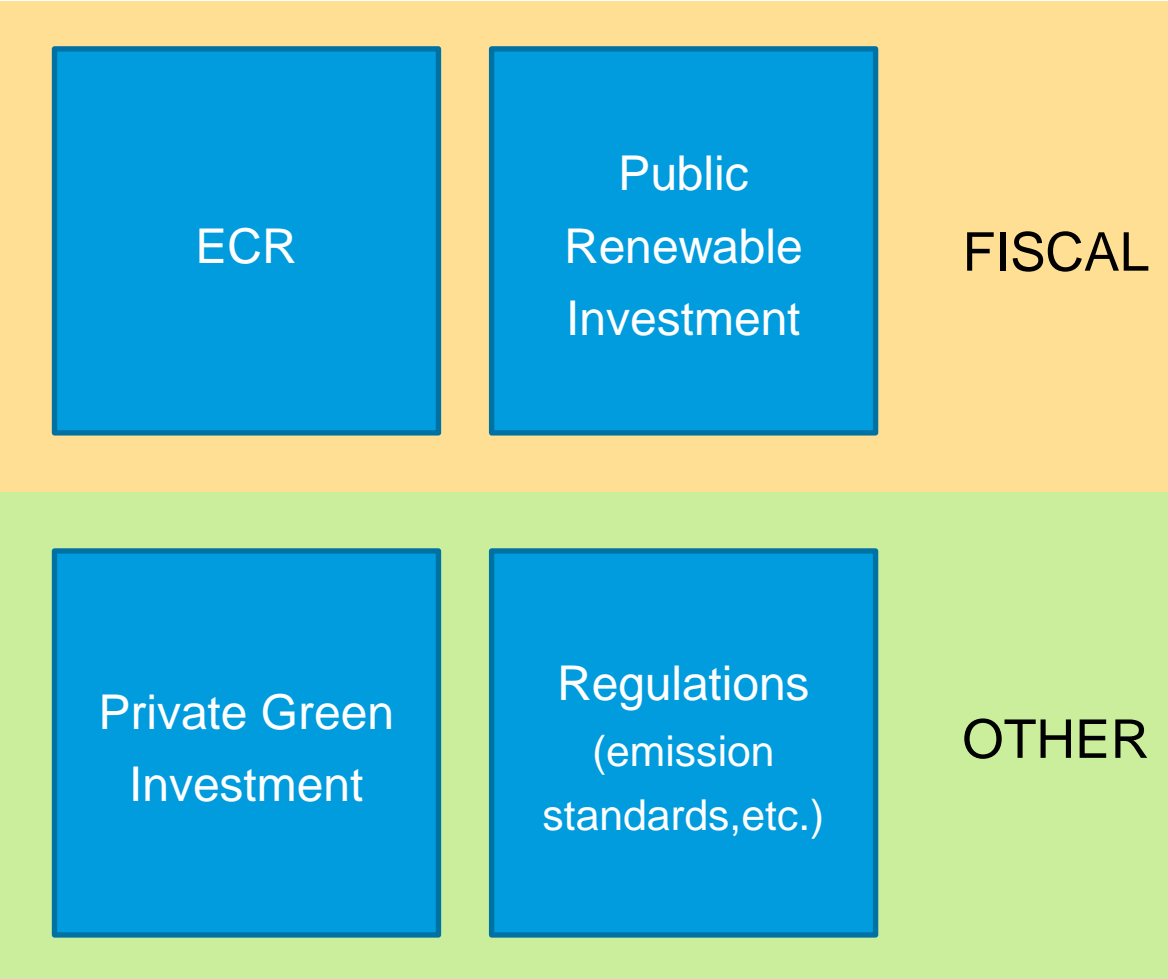
$$Effective\ Carbon\ Rate\ (ECR) = \frac{Fuel\ \&carbon\ taxes + emissions\ permits - fuel\ subsidies}{Total\ CO2\ emissions}$$

A Fiscal Framework: MENAP
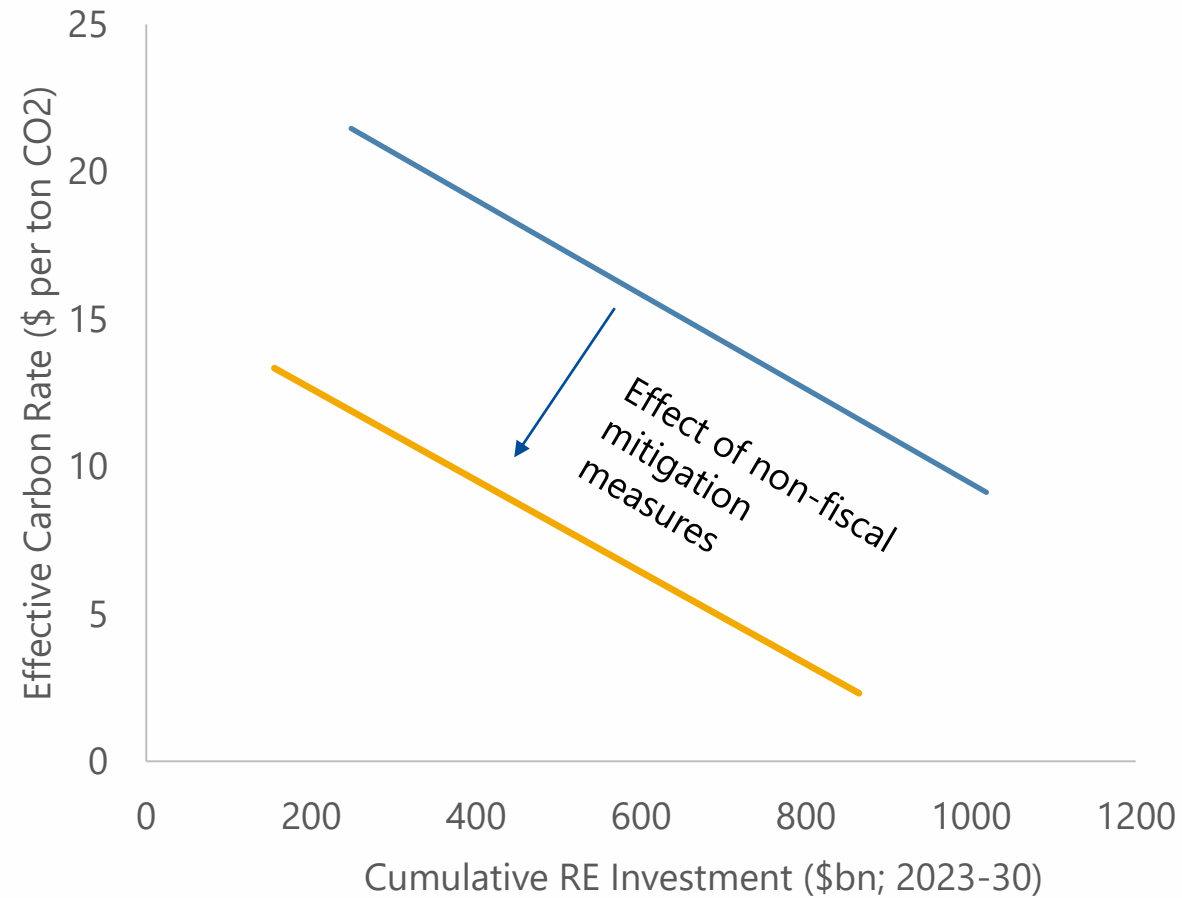
Note: RE stands for renewable energy.

Medium-Term Macroeconomic Trade-Offs: MENAP

	Change in cumulative RE ($bn)	Change in ECR ($ per m-ton CO2)	Change in 2030 GDP (percent)	Change in cumulative borrowing (% of GDP)
Scenario 1 (full FSR + $8 carbon tax)	0	30	-5	-2
Scenario 2 (RE investment + 2/3 FSR)	770	18	4	12
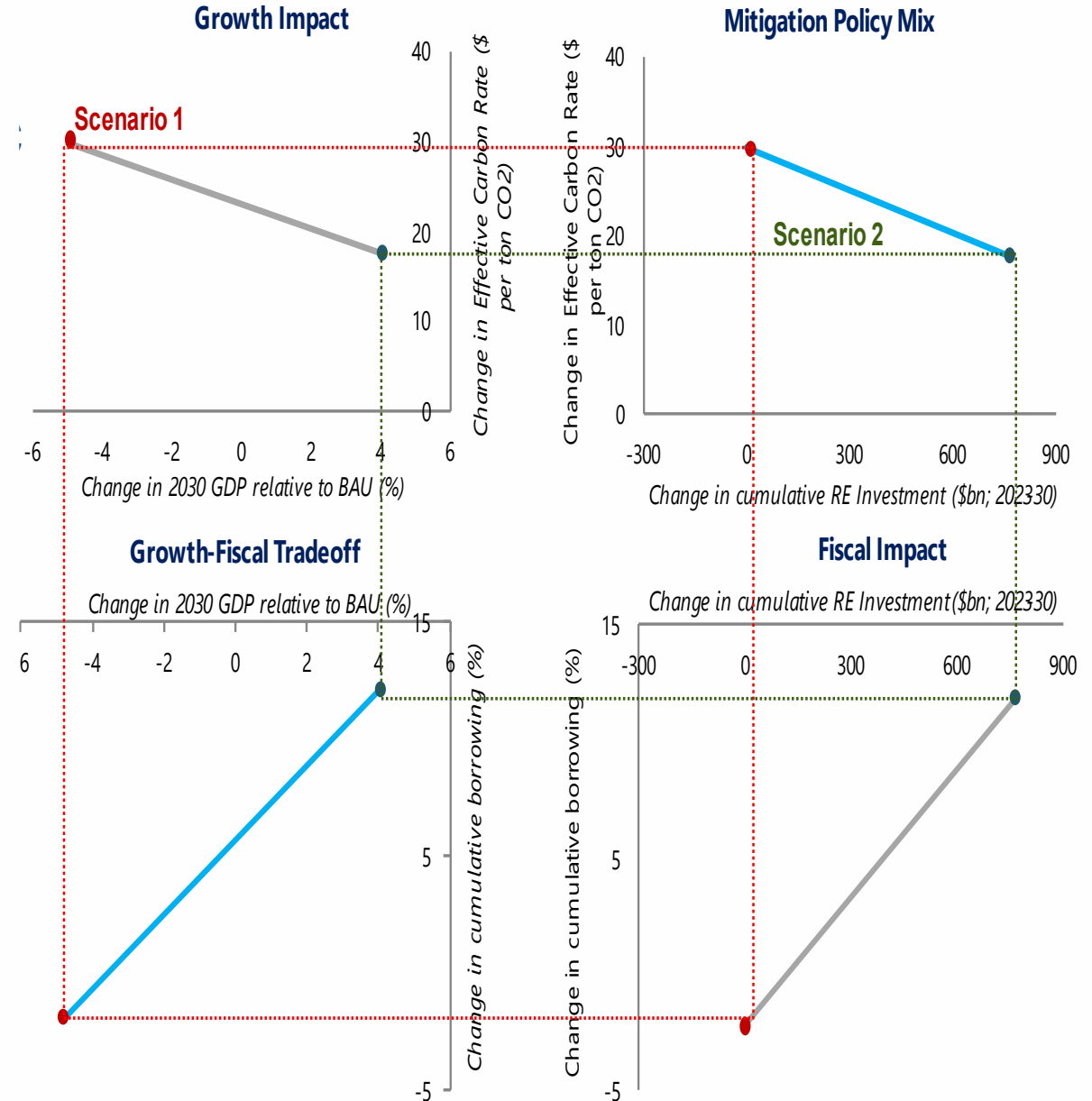
Key Takeaways

1. Reaching the region's emissions targets is no mean feat

2. Fiscal policies could help, options include
   - Raise effective price of fossil fuel
   - Investments in renewables

3. These two policy options involve inter-generational trade-offs

4. Policymakers can choose a mix most suitable to the country

5. The key is to act now

Appendix

Emissions and Energy Prices in ME&CA: 2019
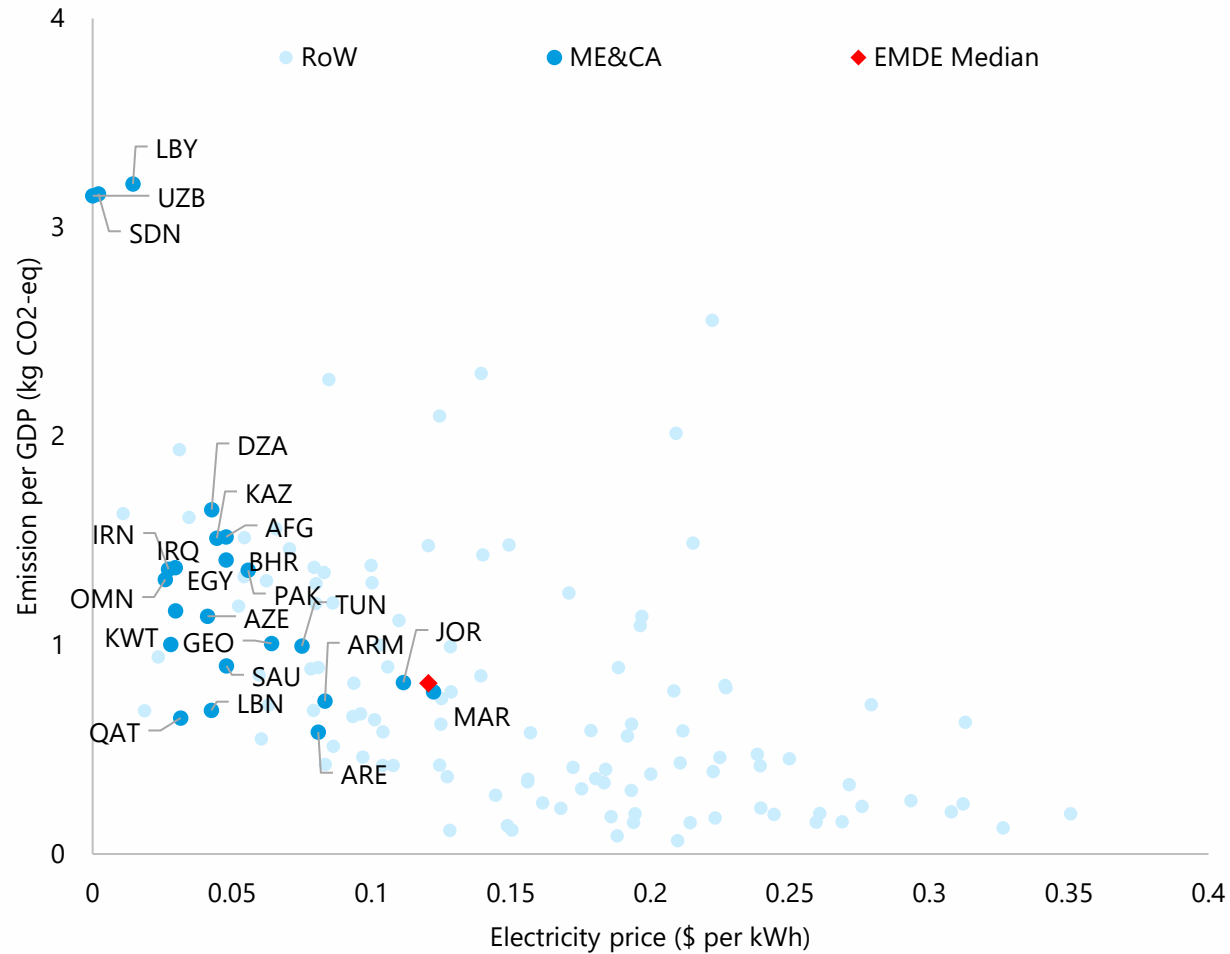
CPAT-BAUs are broadly in line with historical trends

ME&CA Emissions: 1990 – 2030

(In metric-ton CO2-equivalent)

Legend:
- MENA BAU
- MENA BAU (authorities' estimation)
- CCA BAU (rhs)

CPAT projections

CPAT v1.0 structure ('model of models')

Dashboard

A chart-driven, user-friendly interface

- policy – carbon pricing energy/carbon taxes, feebates, ETSs
- revenue use – tax reductions, transfers, expenditures
- complementary policies – fossil fuel & electricity subsidy reform
- advanced module options:
  - key projection sources (IMF, WB, IEA etc.)
  - elasticities (price, income, substitution)
  - rates of improvement
  - other module-specific options

user inputs

Manual inputs

An optional tab for advanced users

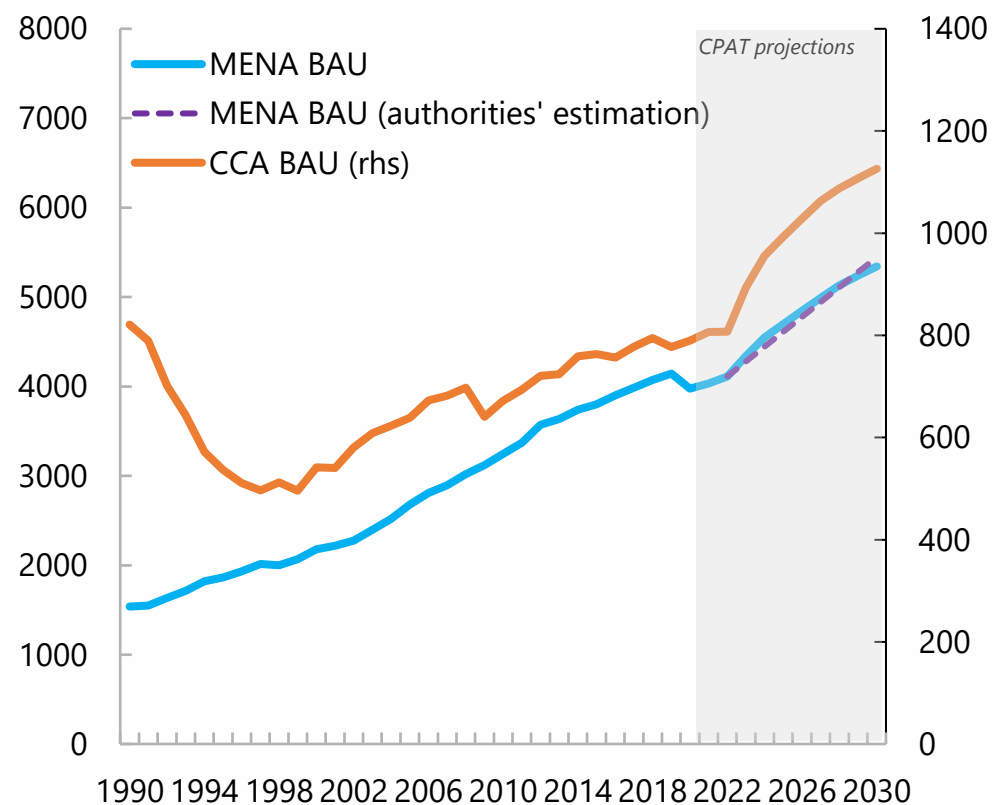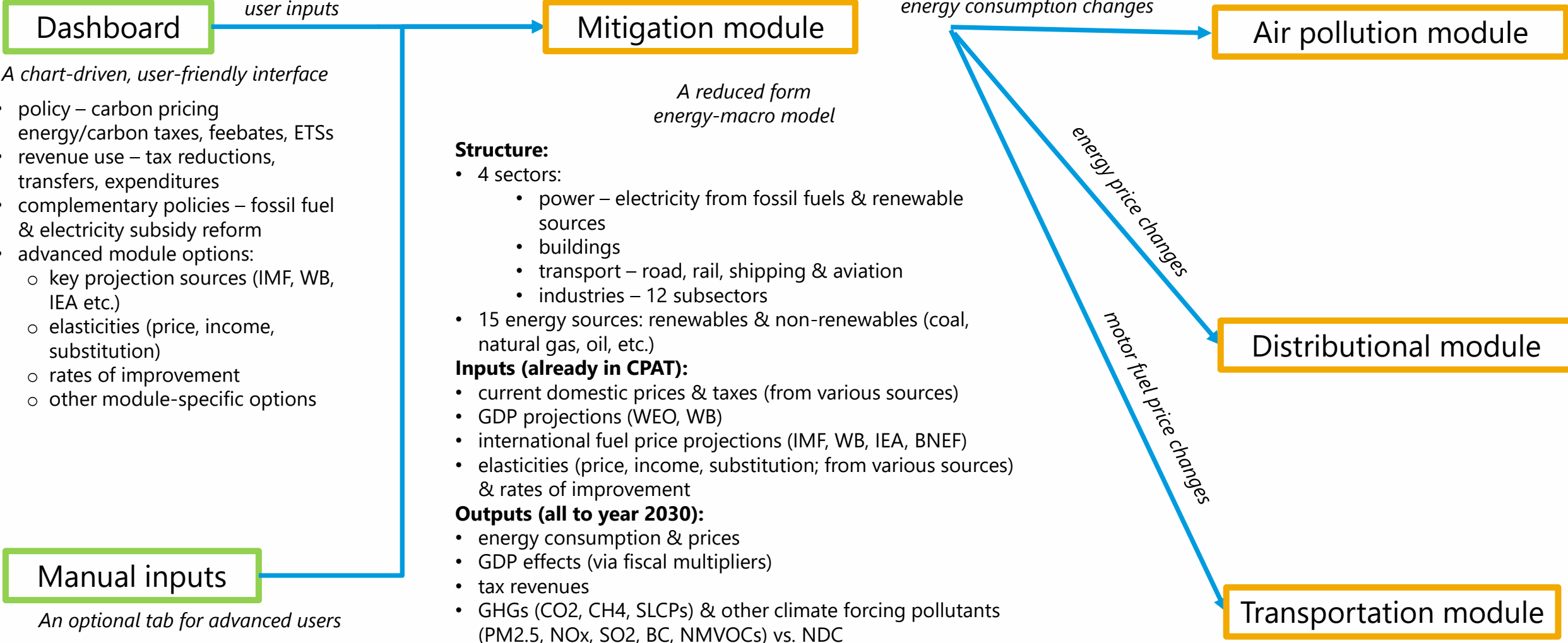- takes inputs from other models (e.g. CGE, DSGE, macrostructural) or where user has more detailed knowledge (e.g. prices, elasticities)

Mitigation module

A reduced form energy-macro model

Structure:
- 4 sectors:
  - power – electricity from fossil fuels & renewable sources
  - buildings
  - transport – road, rail, shipping & aviation
  - industries – 12 subsectors
- 15 energy sources: renewables & non-renewables (coal, natural gas, oil, etc.)

Inputs (already in CPAT):
- current domestic prices & taxes (from various sources)
- GDP projections (WEO, WB)
- international fuel price projections (IMF, WB, IEA, BNEF)
- elasticities (price, income, substitution; from various sources) & rates of improvement

Outputs (all to year 2030):
- energy consumption & prices
- GDP effects (via fiscal multipliers)
- tax revenues
- GHGs (CO2, CH4, SLCPs) & other climate forcing pollutants (PM2.5, NOx, SO2, BC, NMVOCs) vs. NDC

energy consumption changes

Air pollution module

energy price changes

motor fuel price changes

Distributional module

Transportation module

2

General equation for energy demand in mitigation

Sector-specific demand for energy source E $=$ change in usage of energy-consuming products in that sector $\times$ change in energy consumption rate in that sector $\times$ previous sectoral demand for energy

$$Y_t^E = \left(\frac{U_t^E}{U_{t-1}^E} \cdot \frac{h_t^E}{h_{t-1}^E} \right) \cdot Y_{t-1}^E$$

$$\frac{U_t^E}{U_{t-1}^E} = \left(\frac{GDP_t}{GDP_{t-1}} \right)^{v^E} \cdot \left(\frac{h_t^E p_t^E}{h_{t-1}^E p_{t-1}^E} \right)^{\eta^{UEi}}$$

change in usage of energy-consuming products $=$ exogenous change in usage due to GDP growth $\times$ endogenous change in usage due to change in energy prices

$$\frac{h_t^E}{h_{t-1}^E} = \left(1 + \alpha^{Ei} \right)^{-t} \cdot \left(\frac{p_t^E}{p_{t-1}^E} \right)^{\eta^{hE}}$$

change in energy consumption rate $=$ exogenous energy efficiency improvements $\times$ endogenous efficiency improvements (price-induced)

h_t^E = energy consumption rate (inverse of energy efficiency)

p_t^E = price of energy

v^E = (constant) income elasticity of demand for energy-using product

$\eta^{UE} < 0$ = constant price elasticity of demand for use of energy-consuming products wrt. unit energy costs

$\alpha^E \geq 0$ = exogenous energy efficiency improvements (assume 1%)

η^{hE} = elasticity of consumption rate wrt. energy prices

...written another way

$$Y_t^{Ei} = Y_{t-1}^{Ei} \left(\left(1 + \alpha^{Ei}\right)^{-t} \right)^{1+\eta^{UEi}} \left(\frac{GDP_t}{GDP_{t-1}} \right)^{\nu^{Ei}} \left(\frac{p_t^{Ei}}{p_{t-1}^{Ei}} \right)^{\eta^{UEi}+\eta^{hEi}+\eta^{UEi}\eta^{hEi}}$$

sectoral demand for energy E in sector i in year t = previous year's demand x exogenous technical change effect x growth effect (income elasticities) x price effect own price elasticity, endogenous efficiency, and rebound (increased efficiency increases energy demand);

Where:

α^{Ei} = exogenous energy efficiency improvements (e.g. assume 1% improvement per year)

ν^{Ei} = (constant) <u>income</u> elasticity of demand for energy-using product

p_t^{Ei} = price of energy

η^{UEi} = constant price elasticity of <u>demand</u> for energy-consuming products wrt. unit energy costs
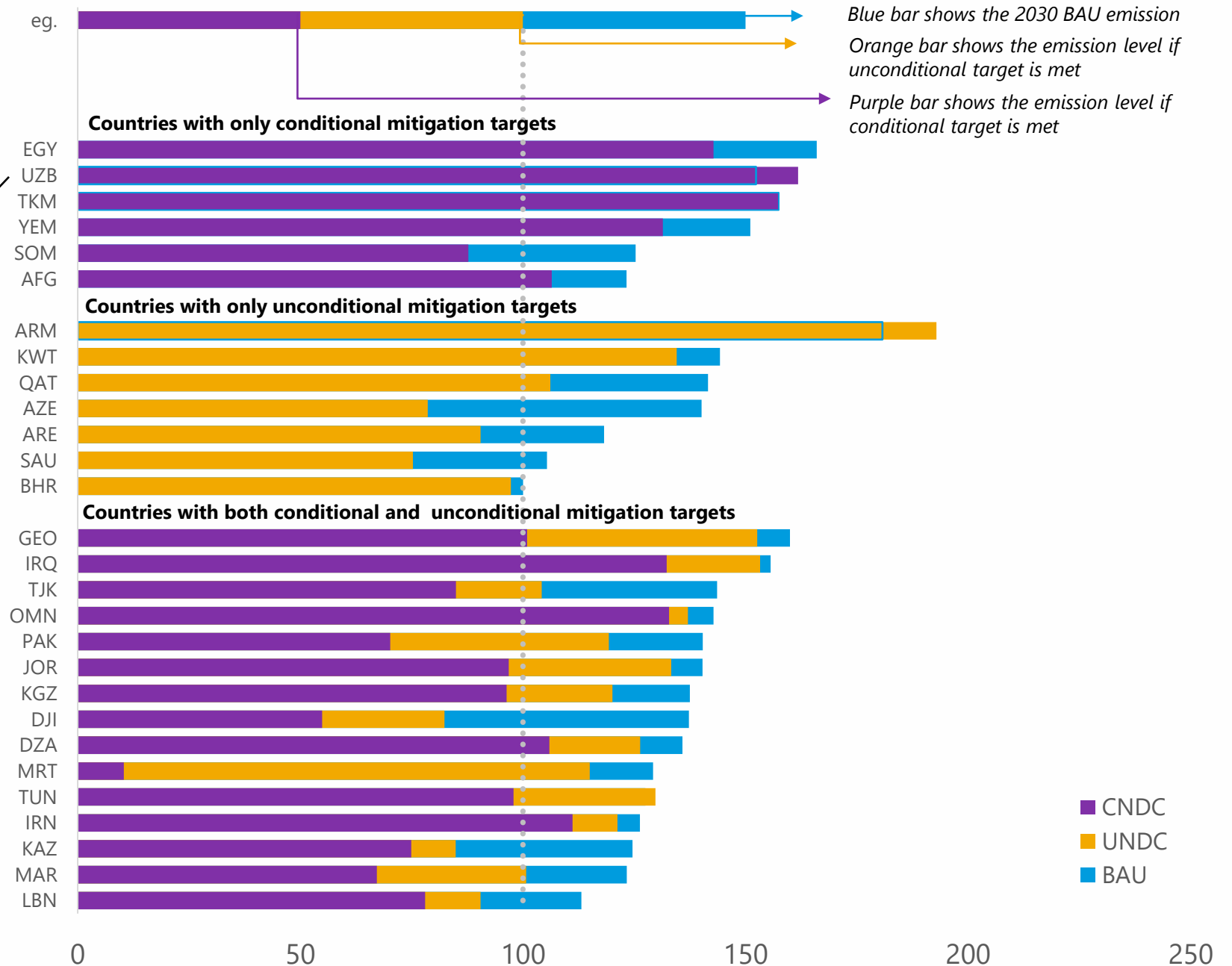
η^{hEi} = elasticity of <u>consumption rate</u> (inverse of energy efficiency) wrt. energy prices

ME&CA BAU Emissions and NDC Targets

(Index; 2022=100)

CPAT projected 2030 BAU for Armenia and Uzbekistan are lower than their mitigation targets.

15 countries will need to cut emission from today's level to achieve their CNDC/UNDC

Blue bar shows the 2030 BAU emission

Orange bar shows the emission level if unconditional target is met

Purple bar shows the emission level if conditional target is met

Countries with only conditional mitigation targets

EGY, UZB, TKM, YEM, SOM, AFG

Countries with only unconditional mitigation targets

ARM, KWT, QAT, AZE, ARE, SAU, BHR

Countries with both conditional and unconditional mitigation targets

GEO, IRQ, TJK, OMN, PAK, JOR, KGZ, DJI, DZA, MRT, TUN, IRN, KAZ, MAR, LBN

■ CNDC
■ UNDC
■ BAU

Note: Excluding West Bank and Gaza due to lack of emission data. Sudan, Syria, and Libya does not have quantifiable mitigation targets.

# Headline numbers: Medium-Term Macroeconomic Outcomes

(Changes relative to BAU)

		Change in cumulative RE ($bn)	Change in ECR ($ per m-ton CO_2)	Change in 2030 GDP (percent)	Change in cumulative borrowing (% of GDP)
MENAP	Scenario 1 (full ESR + $8 carbon tax)	0	30	-5	-2
	Scenario 2 (full ESR+ RE Investment)	406	23	-1	5
	Scenario 3 (RE investment + 2/3 ESR)	770	18	4	12
CCA	Scenario 1 (full ESR + $4 carbon tax)	0	19	-5	-4
	Scenario 2 (full ESR+ RE Investment)	42	16	-2	3
	Scenario 3 (RE investment + 2/3 ESR)	114	13.5	7	15

Power sector mitigation targets

ME&CA Renewable Energy Targets

(In percent of total energy mix/ installed power capacity/ peak installed power)

Legend:
- Current
- 2025
- 2030
- 2035
- 2040
- 2050
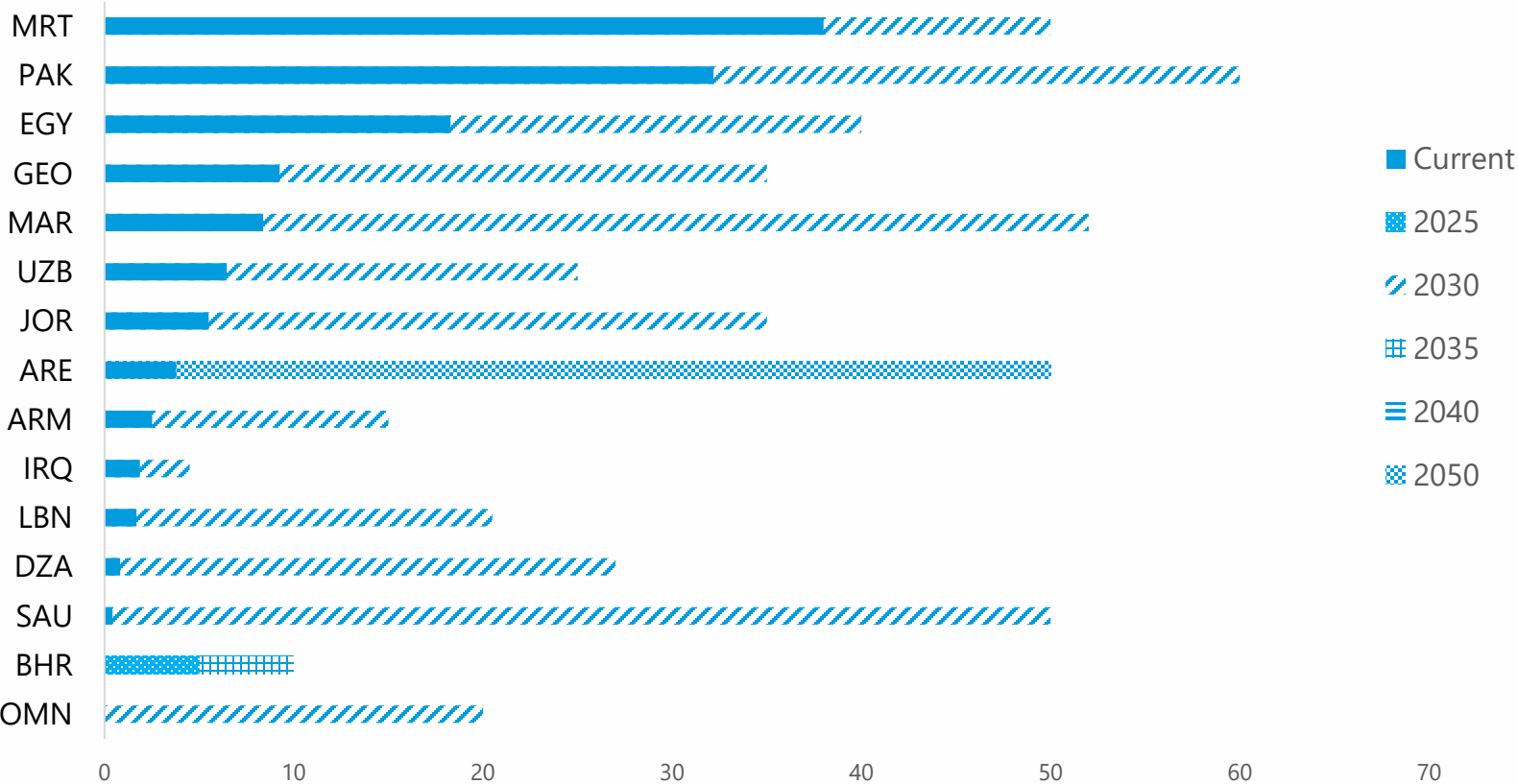
The Climate Policy Assessment Tool (CPAT)

a spreadsheet-based 'model of models' covering **188 countries**

aimed at **economists** in IMF, WB, finance ministries, planning & line ministries

allows rapid estimation of **multiple economic and non-economic effects** of climate mitigation policies such as carbon pricing and fossil fuel subsidy reform:

- **energy & emissions** – energy consumption, global pollutants (GHGs), local pollutants (PM2.5, NOx, SO2, NMVOCs)

- **macroeconomic** – GDP, revenues

- **distributional impacts** – effects of tax and expenditures across income distribution and urban vs. rural

- **development co-benefits** – reductions in mortality & morbidity from improved in air quality and road safety, reduced congestion

being **developed jointly** by IMF (FAD) & WB (SD & EFI)

can **help policymakers design, compare, and implement** carbon pricing reforms, to help them achieve their climate mitigation (Paris Agreement NDCs) and development goals (SDGs) jointly