



Global Trade Analysis Project

GTAP Data Base and Satellite Accounts

Presented by
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2019 ENVISAGE Workshop



Outline

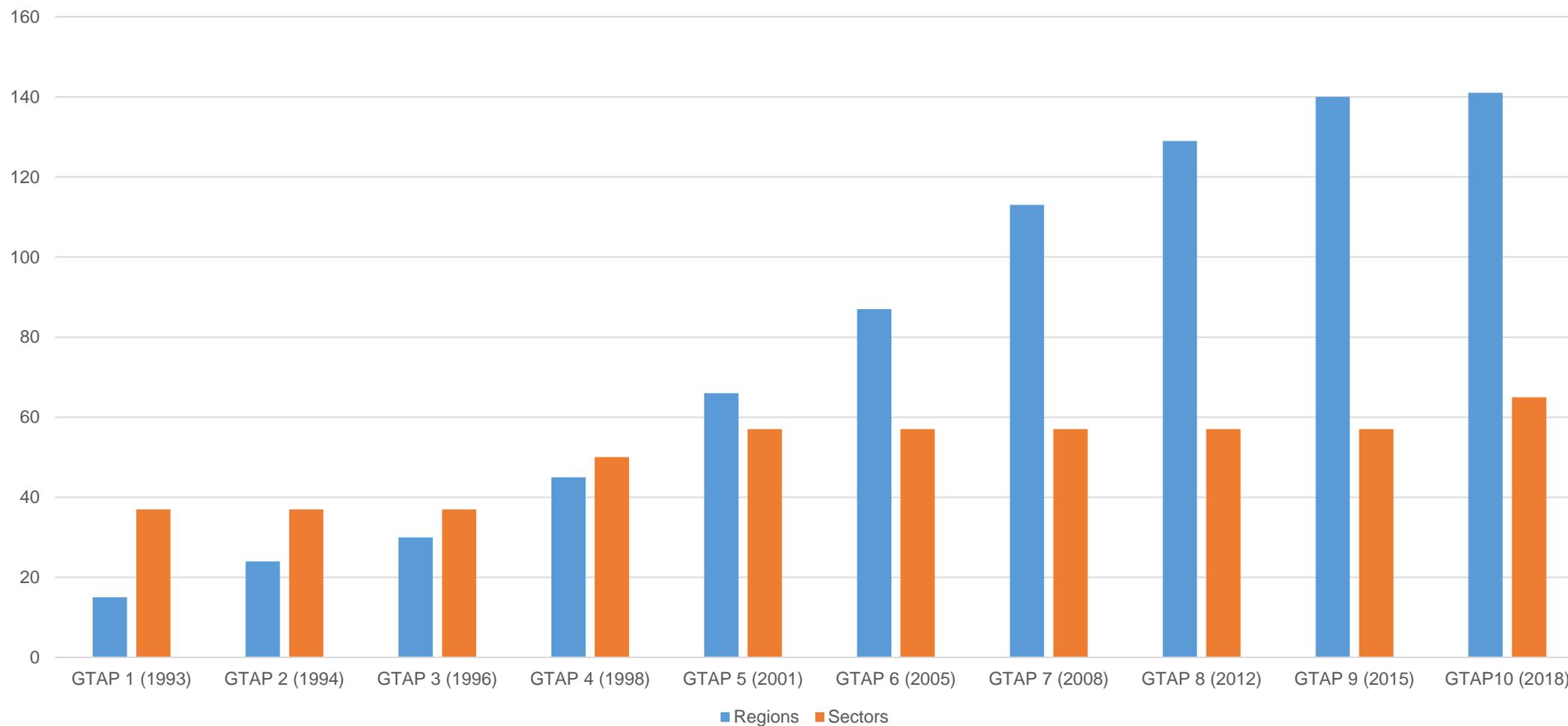
- **Global Trade Analysis Project (GTAP) Data Base:**
 - *Evolution*
 - *Key features*
 - *Construction process*
- **Satellite Accounts used in ENVISAGE:**
 - *Labor, capital and macro accounts*
 - *Energy and emissions*
 - *Land*
 - *Water*

What is GTAP?

- **Global Trade Analysis Project**
- **Based at Purdue University**
- **Consortium of international and government agencies, research institutes and universities, private sector**
- **International database for analysis of international policy issues**
 - Trade, migration, development, energy & the environment, etc.
- **Global GE model also available**
 - Model is known as the GTAP model and is coded using GEMPACK, see Hertel, Thomas, ed. (1997), *Global Trade Analysis: Modeling and Applications*, Cambridge University Press.

Evolution of the GTAP Data Base

Regions and sectors in GTAP since 1992



Increasing Regional Coverage



GTAP 6 – 69 countries



GTAP 7 – 94 countries



GTAP 8 – 109 countries



GTAP 9 – 120 countries

Commodity coverage v9

Paddy rice	Coal	Wood products		Communication
Wheat	Oil	Pulp, paper etc.	Other mach. & eqpt.	Financial services
Other cereals	Gas	Refined oil etc.	Other manu.	Insurance
Vegetables & fruits	Other minerals	Chemicals, rubber and plastics	Electricity	Other bus. services
Oil seeds	Red meat		Gas distribution	
Sugar cane & beet	White meat		Water	Recreation etc.
Plant-based fibers	Vegetable oils	Other mineral prod.	Construction	Public Admin., Educ, Health
Other crops	Dairy products	Ferrous metals	Trade	
Beef etc.	Processed rice	Other metals	Other transport	Dwellings
Poultry, pork, etc.	Refined sugar	Metal products		
Raw milk	Other food	Mot. vehicles & parts		
Wool etc.	Beverages & tobacco	Oth. trp. eqpt.	Sea transport	
Forestry	Textiles	Electronic eqpt.	Air transport	
Fishing	Clothing			
	Leather products			

Agriculture etc.

Processed food

Energy intensive

Oth. Manufacturing

Services

Commodity coverage v10

Paddy rice	Coal	Wood products	Electrical eqpt.	Communication
Wheat	Oil	Pulp, paper etc.	Other mach. & eqpt.	Financial services
Other cereals	Gas	Refined oil etc.	Other manu.	Insurance
Vegetables & fruits	Other minerals	Pharmaceuticals	Electricity	Real estate
Oil seeds	Red meat	Other chemicals	Gas distribution	Other bus. services
Sugar cane & beet	White meat	Rubber & plastics	Water	Recreation etc.
Plant-based fibers	Vegetable oils	Other mineral prod.	Construction	Public Admin.
Other crops	Dairy products	Ferrous metals	W & R trade	Education
Beef etc.	Processed rice	Other metals	Hotels, rests. etc.	Health
Poultry, pork, etc.	Refined sugar	Metal products	Warehousing etc.	Dwellings
Raw milk	Other food	Mot. vehicles & parts	Land transport	
Wool etc.	Beverages & tobacco	Oth. trp. eqpt.	Sea transport	
Forestry	Textiles	Electronic eqpt.	Air transport	
Fishing	Clothing			
	Leather products			

Agriculture etc.

Processed food

Oth. Manufacturing

Energy intensive

Services

GTAP Data Base Release History

Release	Released	Regions	Sectors	Reference Years
GTAP 1	1993	15	37	1990
GTAP 2	1994	24	37	1992
GTAP 3	1996	30	37	1992
GTAP 4	1998	45	50	1995
GTAP 5	2001	66	57	1997
GTAP 6	2005	87	57	2001
GTAP 7	2008	113	57	2004
GTAP 8.1	2012	134	57	2004, 2007
GTAP 9a	2016	140	57	2004, 2007, 2011
GTAP 10	2019	141	65	2004, 2007, 2011, 2014

Structure of the GTAP Data Base

- **National input/output tables**
- **Bilateral trade and protection data**
 - Export taxes/subsidies
 - International trade and transport margins (FOB, CIF)
 - Bilateral import tariffs
- **Other international data sources**
 - Macro
 - Agriculture
 - Energy
- **“FIT” procedure to make consistent world accounting framework**

I-O Data

- **I-O tables are contributed by users**
 - Guidelines included in the GTAP website
- **Of the 140 GTAP regions in GTAP 9:**
 - 120 country tables - from national statistics
 - 20 composite regions - from country tables
- **Sectoral classification:**
 - Full 57 sectors not required; separate food and agriculture, energy, other
- **Sign conditions: no negative flows except in changes in stocks**
- **No ridiculous tax rates**
- **Sectoral balance condition: Total sales = Total costs**

Clean, Disaggregate, Synthesize

- **Clean**

- Remove small remaining problems with balance and sign.

- **Disaggregate**

- Of the 140 regions in GTAP 9:
 - 15 I-O tables have all 57 sectors; no disaggregation needed
 - 68 tables need agricultural disaggregation; use Agricultural I-O table
 - 105 tables need non-agricultural disaggregation as well; use representative table

- **Synthesize**

- Create 20 composite regions

Sectoral Disaggregation

pdr	wht	gro	v_f	osd	c_b	pfb	ocr	ctl	oap	rmk	wol
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China



Indonesia



Sri Lanka



Composite Regions: Rules

- **Match each member country to a primary region**
 - by per capita GDP
 - only within geographic regions
- **Composite region I-O table is linear combination of primary region I-O tables.**

International Data Sources

agricultural data set

fao.org/faostat

macro data set

wdi.worldbank.org/tables

trade data set

comtrade.un.org/data

protection data set

PSE-oecd, tariff-ITC

energy data set

iea.org/statistics/

Agricultural I-O Data

- Original source: UN's FAO, *Supply Utilization Statistics*
- Proximate source: Everett Peterson
- Provides cost structures and sales dispositions for agricultural and food commodities
- Adjust contributed I-O tables

Macroeconomic Data

- WDI, World Bank
- Contents: GDP, C , I , G
- Consistency:

$$\text{GDP} = C + I + G + \underline{X - M}$$

- Adjust C , I , G to preserve GDP and balanced trade data

Trade Data

- **Merchandise:**
 - UN Commodity Trade Statistics (Mark Gehlhar)
- **Non-margin Services:**
 - IMF Balance of Trade Statistics;
 - OECD, data adapted by Arjan Lejour and Nico van Leeuwen, CPB
- **International transport margins:**
 - COMTRADE; IMF BTS; (modal shares) US Census Bureau Foreign Trade Statistics (Mark Gehlhar)

Protection Data

- **Import duty rates (next slides)**
- **For agriculture:**
 - Export subsidy rates
 - Output subsidy rates
 - Input subsidy rates
- **Agreement on Textiles and Clothing (ATC)**
 - Export Tax Equivalents (ETEs) for textiles and clothing
- **Overrides: I-O tables**
- **Does not override: rates of tax on energy inputs into agriculture**

MAcMapHS6

- **Market Access Maps (MAcMapHS6) an exhaustive, and bilateral snapshot of world protection**
 - Developed by ITC (International Trade Centre)
 - Main data sources
 - ITC and National (Country) Statistical Sources like USITC, TARIC
- **Country and Commodity Coverage**
 - 190 reporting countries (importers) and 238 partner countries (exporters)
 - Commodities at the 6-digit level of the harmonized system (HS6)
 - 5,052 product categories

MAcMapHS6 v3 includes

- **At the HS6 level MAcMapHS6 includes**
 - Ad-valorem component
 - Ad-valorem equivalent (AVE) of specific component
 - Consistently accounts for tariff rate quotas (TRQs)
- **Ad-valorem and specific duties take into account an exhaustive list of preferences**
 - Through regional and bilateral trade agreements
 - Generalized Scheme of Preferences (GSP) to DCG and LDC

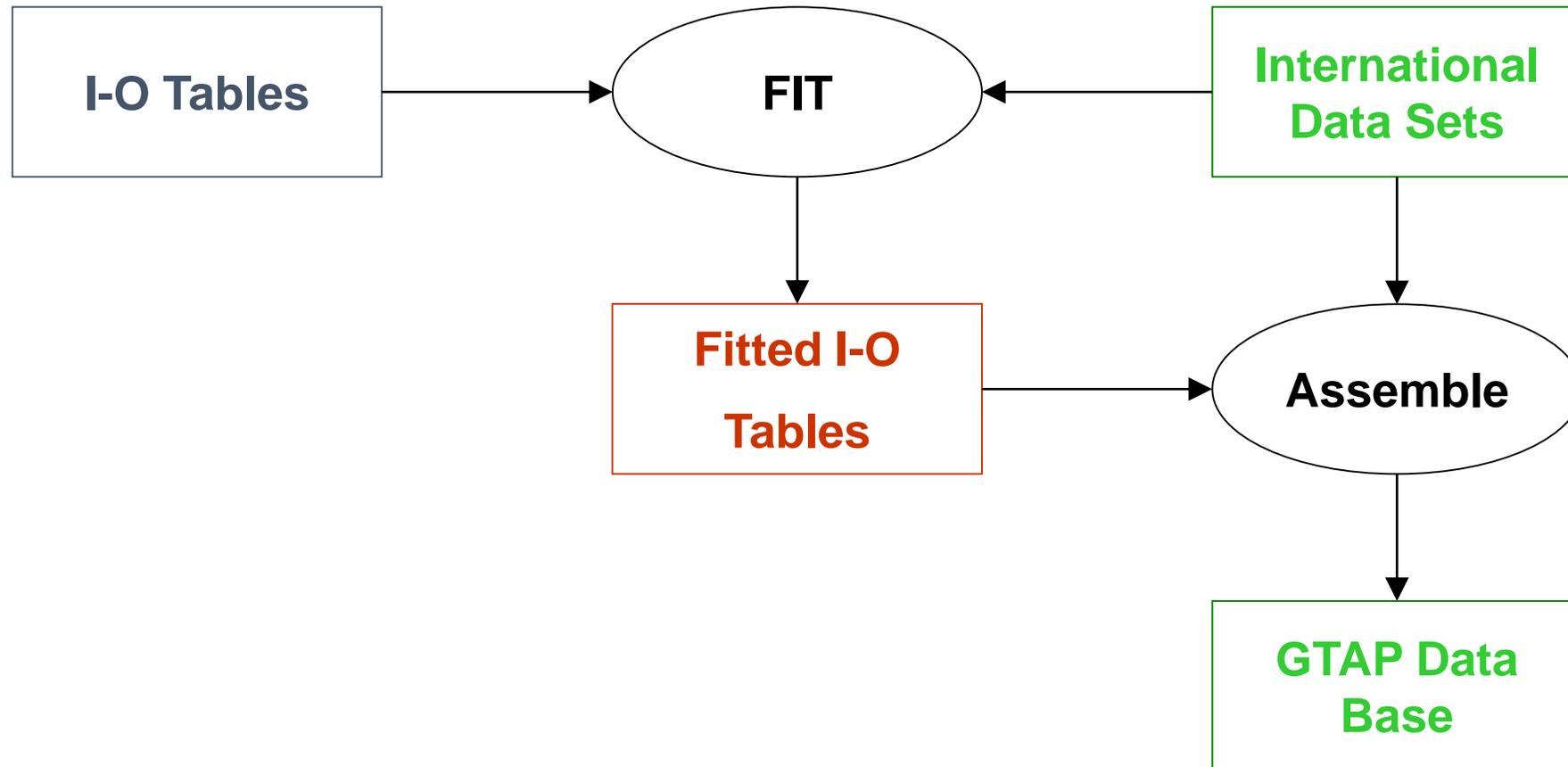
Energy Data

- **International Energy Agency**
- **Contents:**
 - Physical data
 - Prices
 - Tax Rates
- **Provides energy trade, cost structures, sales dispositions, tax rates**
- **Overrides: Trade data, I-O tables**

FIT: Updating and Reconciliation

- Eliminate changes in stocks
- Reconcile with international data sets
- Entropy theoretic approach

Construction Process



Basedata.har

basedata.har in c:\runctap5\ncors3x3

File Contents Export History Search Programs Help

	Header	Type	Dimension	Coeff	Total	Name
1	DVER	RE	1	DVER	5.00	version of GTAP data
2	DPSM	RE	REG	DPSM	3.00	Share-weighted sum of distribution parameters
3	EVFP	RE	ENDW*ACTS*REG	EVFP	25917713	primary factor purchases, at producers prices
4	EVOS	RE	ENDW*ACTS*REG	EVOS	25917714	value of endowment supply in region r, net of direct tax
5	SAVE	RE	REG	SAVE	2799012	Savings - Net Expenditure at Agents' Prices
6	VOSB	RE	COMM*REG	VOSB	53624172	sales of domestic output supply, at basic prices
7	VDEP	RE	REG	VDEP	3274395	Capital Stock - Value of Depreciation
8	VDFP	RE	COMM*ACTS*REG	VDFP	22969641	domestic purchases, by firms, at producers prices
9	VDFB	RE	COMM*ACTS*REG	VDFB	22697334	domestic purchases, by firms, at basic prices
10	VDGP	RE	COMM*REG	VDGP	4179484	domestic purchases, by government, at producers prices
11	VDGB	RE	COMM*REG	VDGB	4146621	domestic purchases, by government, at basic prices
12	VDPP	RE	COMM*REG	VDPP	16293990	domestic purchases, by households, at producers prices
13	VDPB	RE	COMM*REG	VDPB	15719091	domestic purchases, by households, at basic prices
14	VDIP	RE	COMM*REG	VDIP	5203020	domestic purchases, by investment, at producers prices
15	VDIB	RE	COMM*REG	VDIB	5114616	domestic purchases, by investment, at basic prices
16	EVFB	RE	ENDW*ACTS*REG	EVFB	25917713	primary factor purchases, by firms, at basic prices
17	VMFP	RE	COMM*ACTS*REG	VMFP	3755366	imported purchases, by firms, at producers prices
18	VMFB	RE	COMM*ACTS*REG	VMFB	3714456	imported purchases, by firms, at basic prices
19	VMGP	RE	COMM*REG	VMGP	177364	import purchases, by government, at producers prices
20	VMGB	RE	COMM*REG	VMGB	174781	import purchases, by government, at basic prices
21	VMPP	RE	COMM*REG	VMPP	1581202	import purchases, by households, at producers prices

*Glossary also included in Corong et al. (2017) <http://dx.doi.org/10.21642/JGEA.020101AF>

Social Accounting Matrix (SAM) for GTAP

	ACT	DOM	IMP	VA	TTAX	REGH	PRIV	GOV	INV	DEPR	ITT	TRADE	ROW	Total
Activities		MAKES												VOS
Domestic commodities	VDFB						VDPB	VDGB	VDIB		VST	VFOB		VOSB+XTAX
Imported commodities	VMFB						VMPB	VMGB	VMIB					VMSB
Value added	EVFB													EVFB
Tax on dom. commodities	VDFP- VDFB						VDPP- VDPB	VDGP- VDGB	VDIP- VDIB					DTAX
Tax on imp. commodities	VMFP- VMFB						VMPP- VMPB	VMGP- VMGB	VMIP- VMIB					ITAX
Tax on factor use	EVFP- EVFB													ETAX
Production tax		MAKEB- MAKES												PTAX
Import tax			VMSB- VCIF											MTAX
Export tax		VFOB- VXSB												XTAX
Income tax				EVFB- EVOS										YTAX
Regional household				EVOS	TTAX									REGY
Private expenditures							PRIVEXP							PRIVEXP
Public expenditures							GOVEXP							GOVEXP
Investment expenditures							SAVE			VDEP			SAVF	EINV
Depreciation allowance							VDEP							VDEP
Margin exports													VST	VST
Trade			VCIF										VFOB- VCIF	VFOB
Balance of payments														0
Total	VOS	VOSB+XTAX	VMSB	EVFB	TTAX	REGY	PRIVEXP	GOVEXP	EINV	VDEP	VST	VFOB	0	

Satellite accounts

▪ Standard

- Times series of bilateral merchandise trade flow (199x-201x)
- Energy consumption in MTOE and CO₂ emissions from fuel combustion

▪ Additional

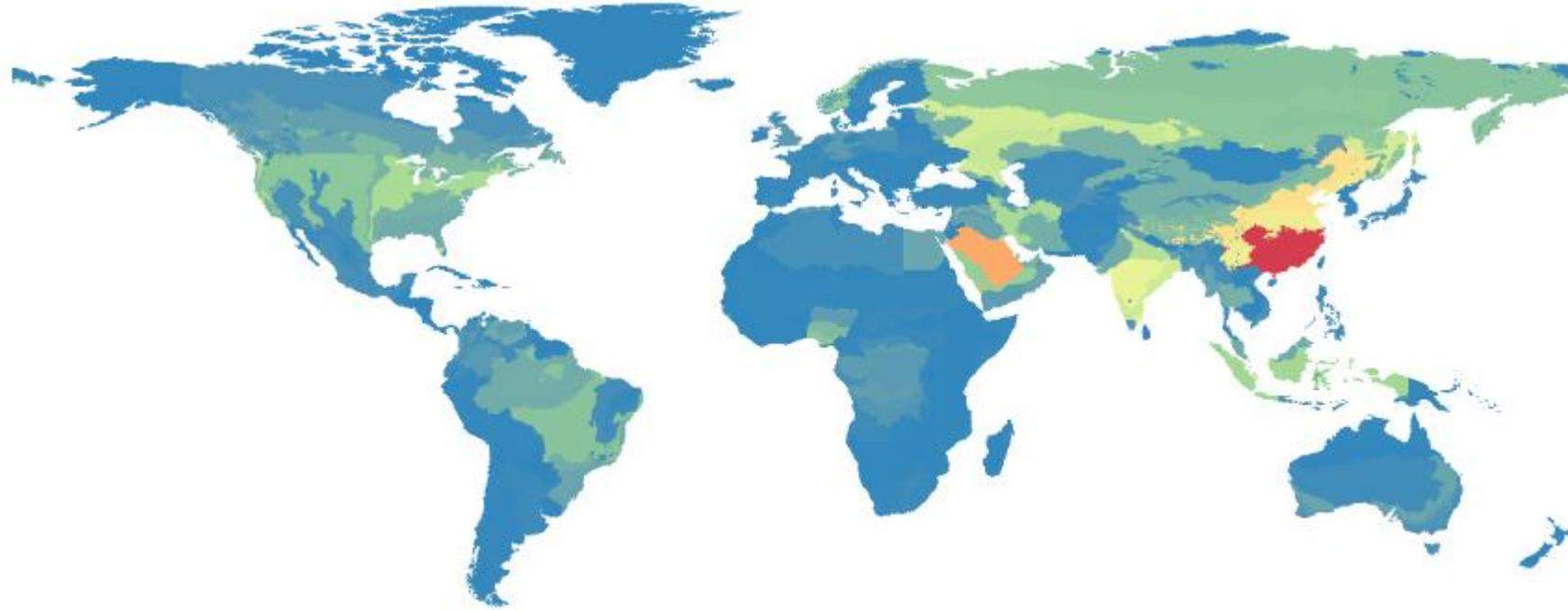
- Bilateral stock of foreign-born population and workers (by skill)
- Cross-border flows of capital income
- Emissions of other greenhouse gases (N₂O, CH₄, F-gases)
- Air pollution (10 air pollutants)
- Land use (18 agro-ecological zones—AEZs) and forestry coverage

▪ Special databases

- Power database (electricity production split into 11 sources (thermal, nuclear, hydro, renewables, etc.) + transmission & distribution)
- Water database (rain-fed and irrigated crops, aggregate water use for livestock, municipal and industrial)
- Energy subsidies database (country-specific fossil-fuel consumption subsidies)

GTAP Land Use and Land Cover Database

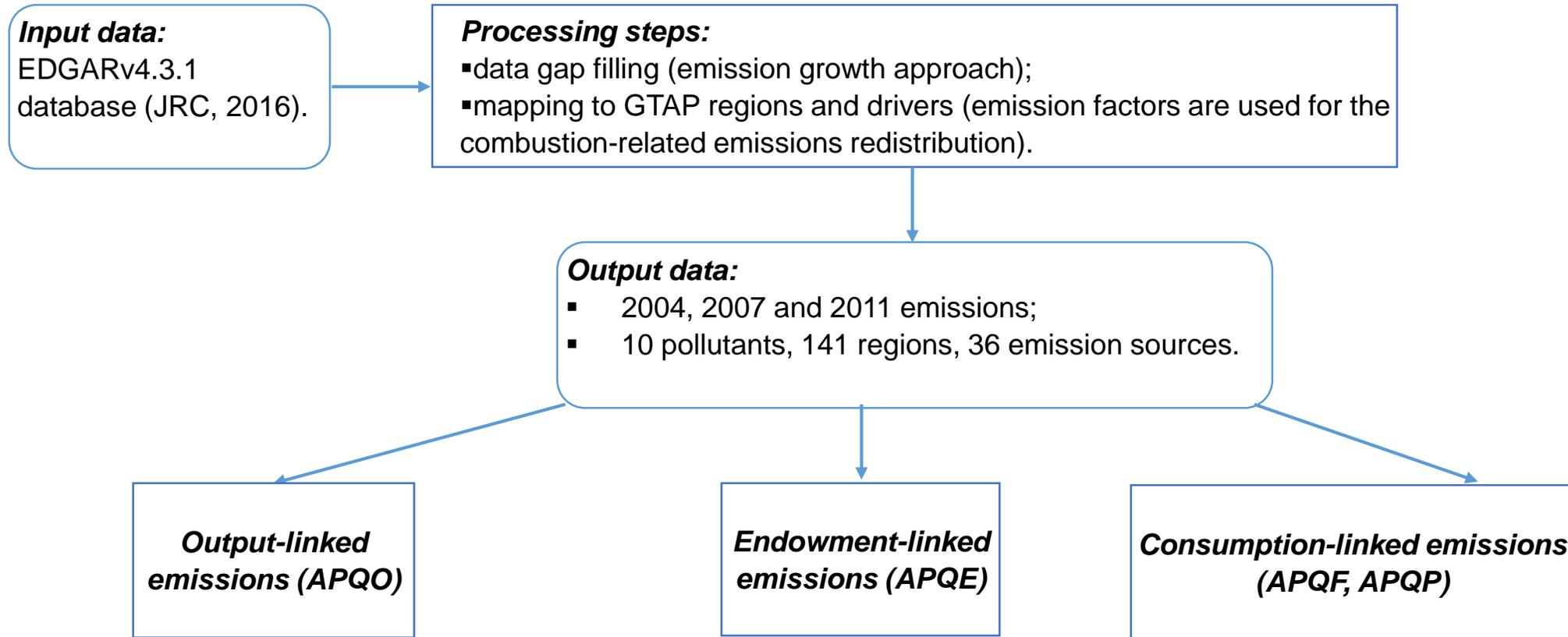
- **Key data sources:** FAO, IIASA; urban, crop and pasture cover; crop output, harvested area, livestock output. 5-minute land cover and land use maps.
- **Data treatment:** 5-minute resolution data is mapped to GTAP regions and sectors



EVOA Y2011 (B\$) 0 10 20 30 40 50 60 70 80 90 100

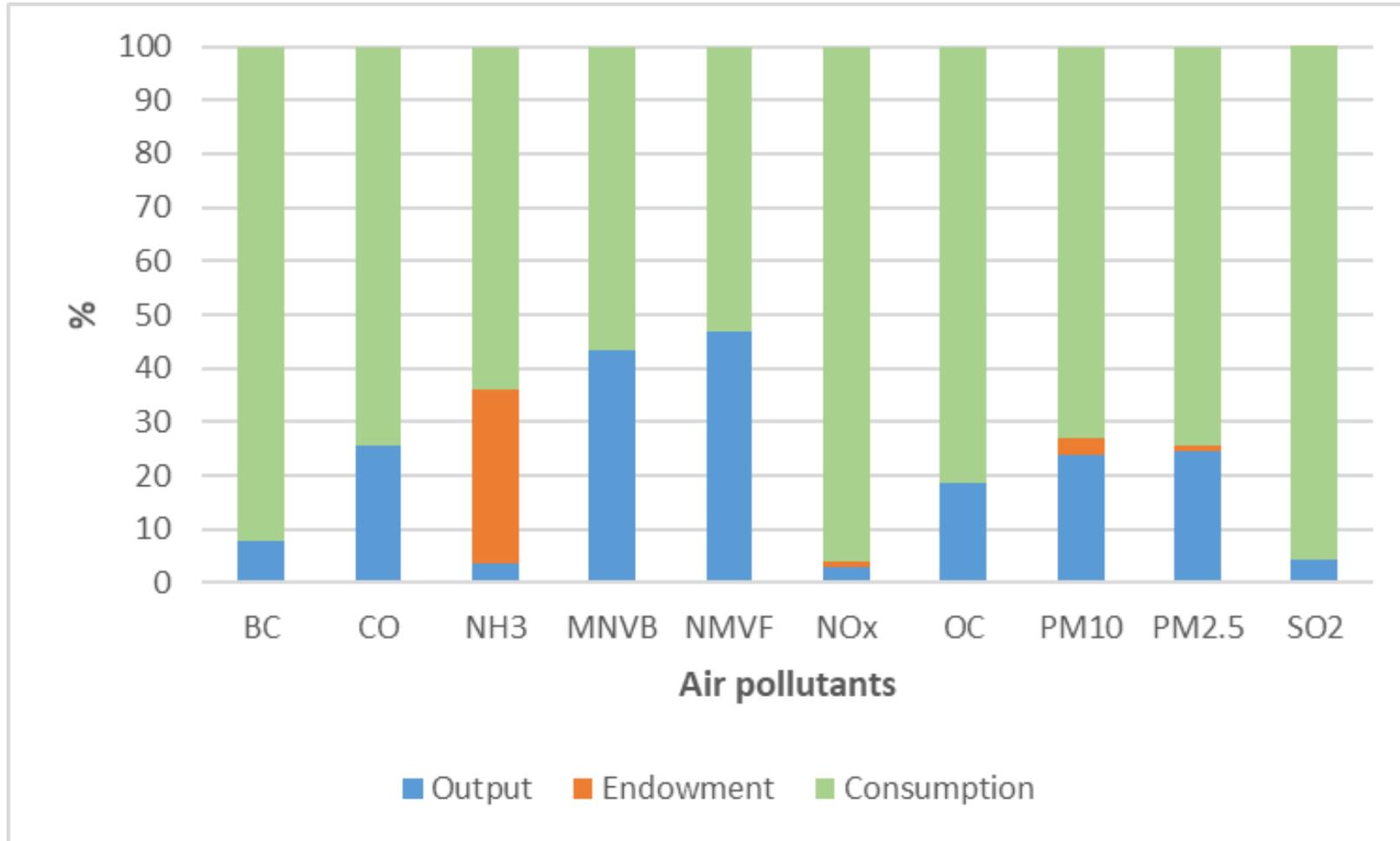
Value of land endowment by region and AEZ in 2011, bn USD

Air Pollution Database: Construction Process



Source: Chepeliev (2018).

Air pollution drivers

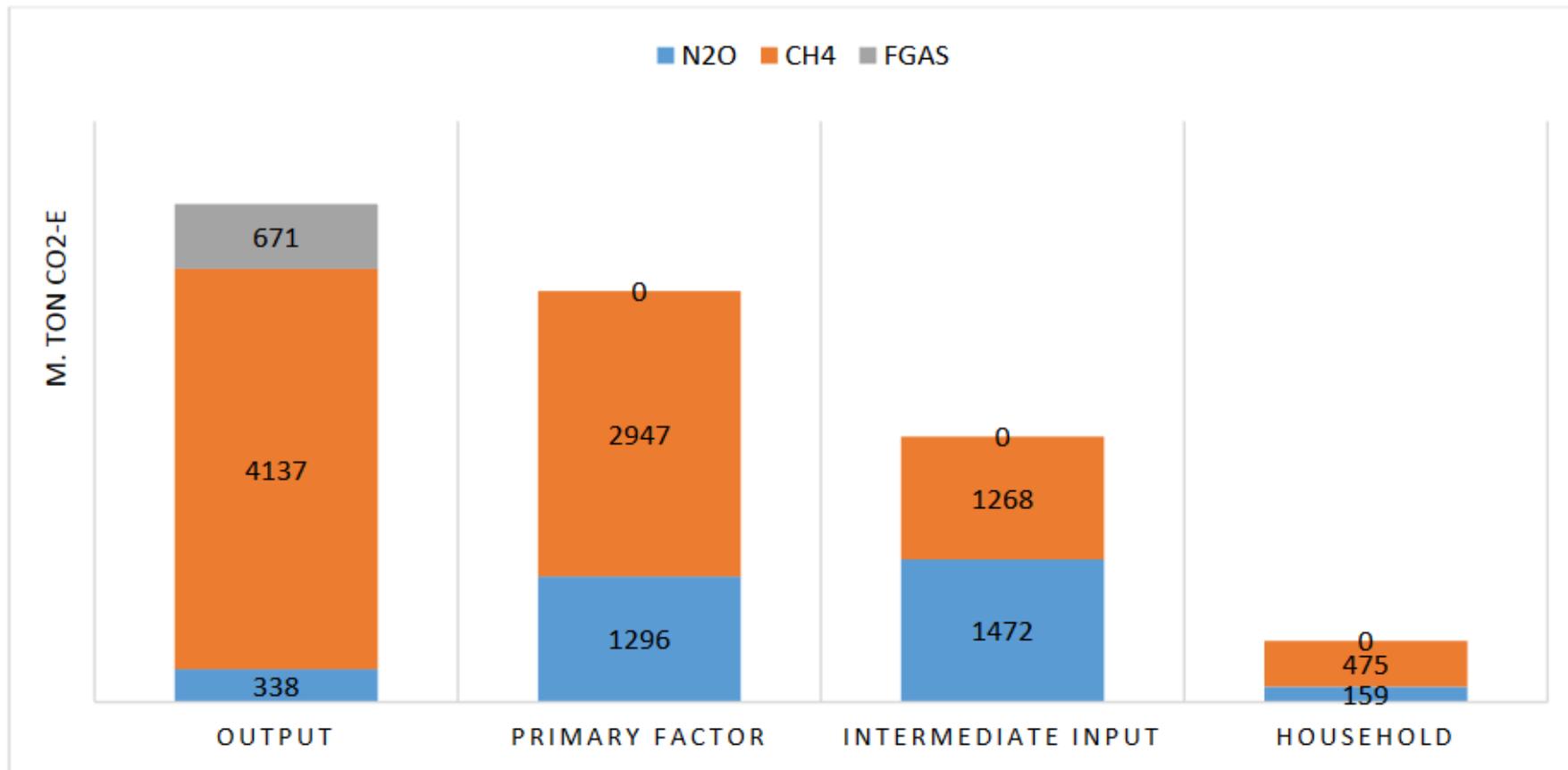


No.	Pollutant	Pollutant name
1	BC	Black carbon
2	CO	Carbon monoxide
3	NH ₃	Ammonia
4	NMVB	Non-methane volatile organic compounds (short cycle carbon)
5	NMVF	Non-methane volatile organic compounds (long cycle carbon)
6	NO _x	Nitrogen oxides
7	OC	Organic carbon
8	PM10	Particulate matter 10
9	PM2.5	Particulate matter 2.5
10	SO ₂	Sulfur dioxide

Source: Authors estimates based on EDGARv4.3.1 database (JRC, 2016).

Non-CO2 GHG emissions

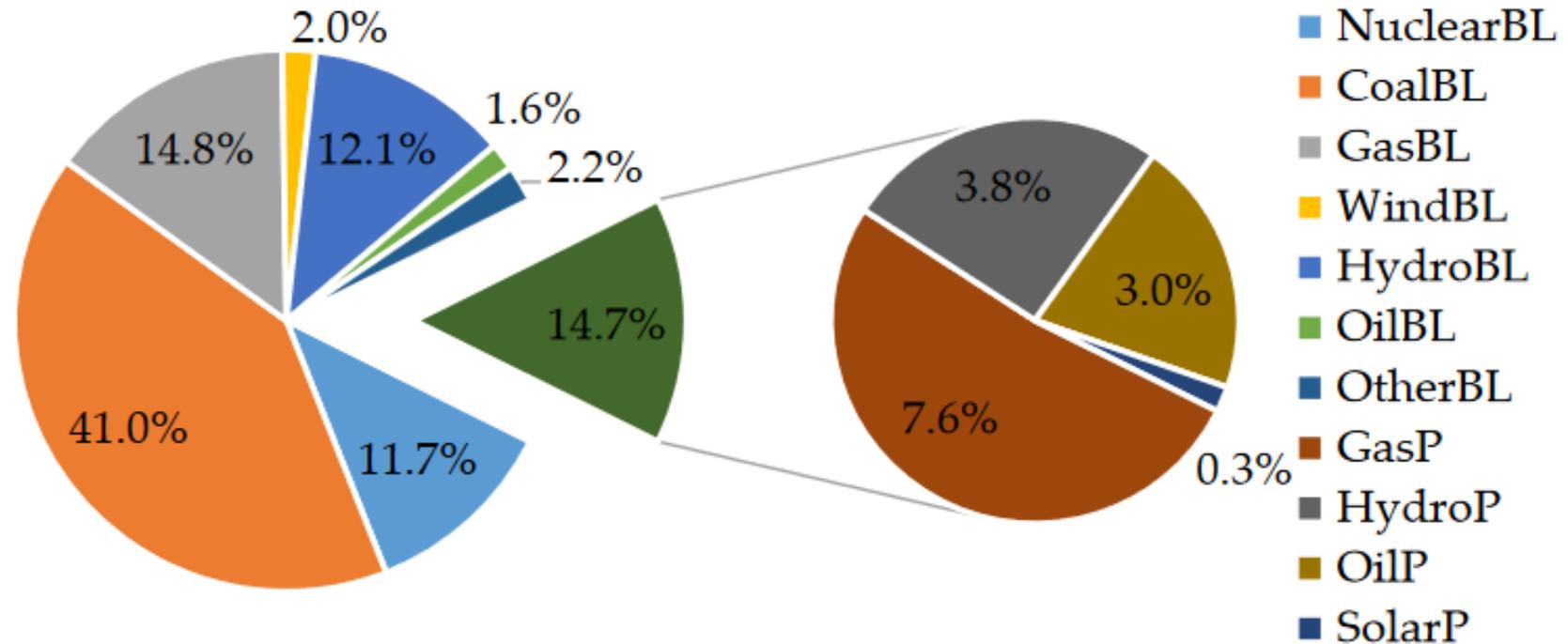
- **Key data sources:** EDGAR (non-agriculture) and FAOSTAT (agriculture)
- **Data treatment:** gap-filling and mapping to GTAP economic drivers



Global non-CO2 GHG emissions by economic driver in 2011

GTAP-Power Database

- Several approaches to the GTAP electricity sector disaggregation prior to GTAP-Power (MIT – Joint Program, GEM-E3, GTEM, OECD ENV-Linkages, etc.)
- Electricity sector is split into 11 generation technologies + transmissions and distribution (57 sectors -> 65 sectors)

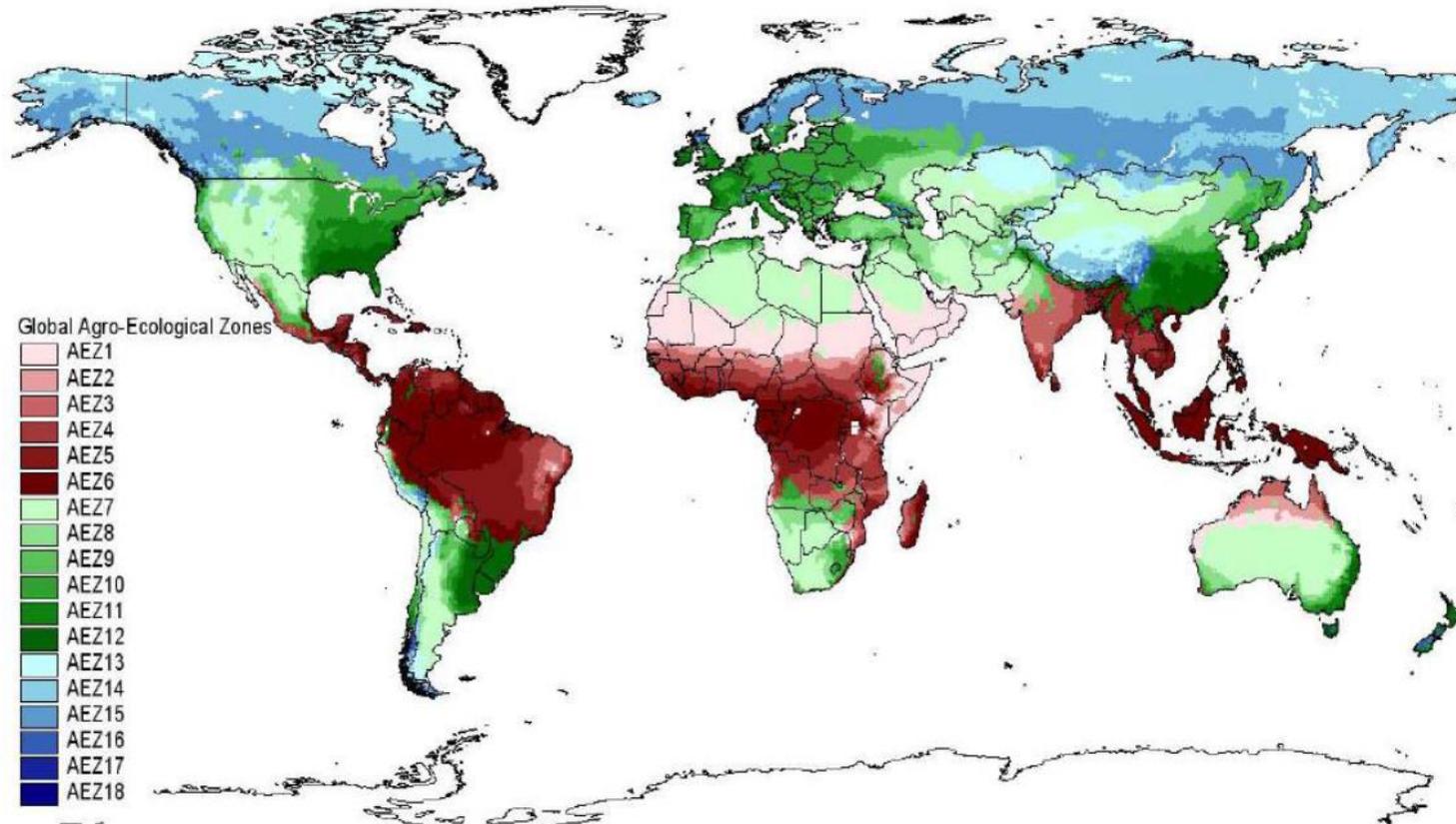


Shares of global electricity generation from different technologies in base and peak (green cut-out) load (2011)

Source: Peters (2016)

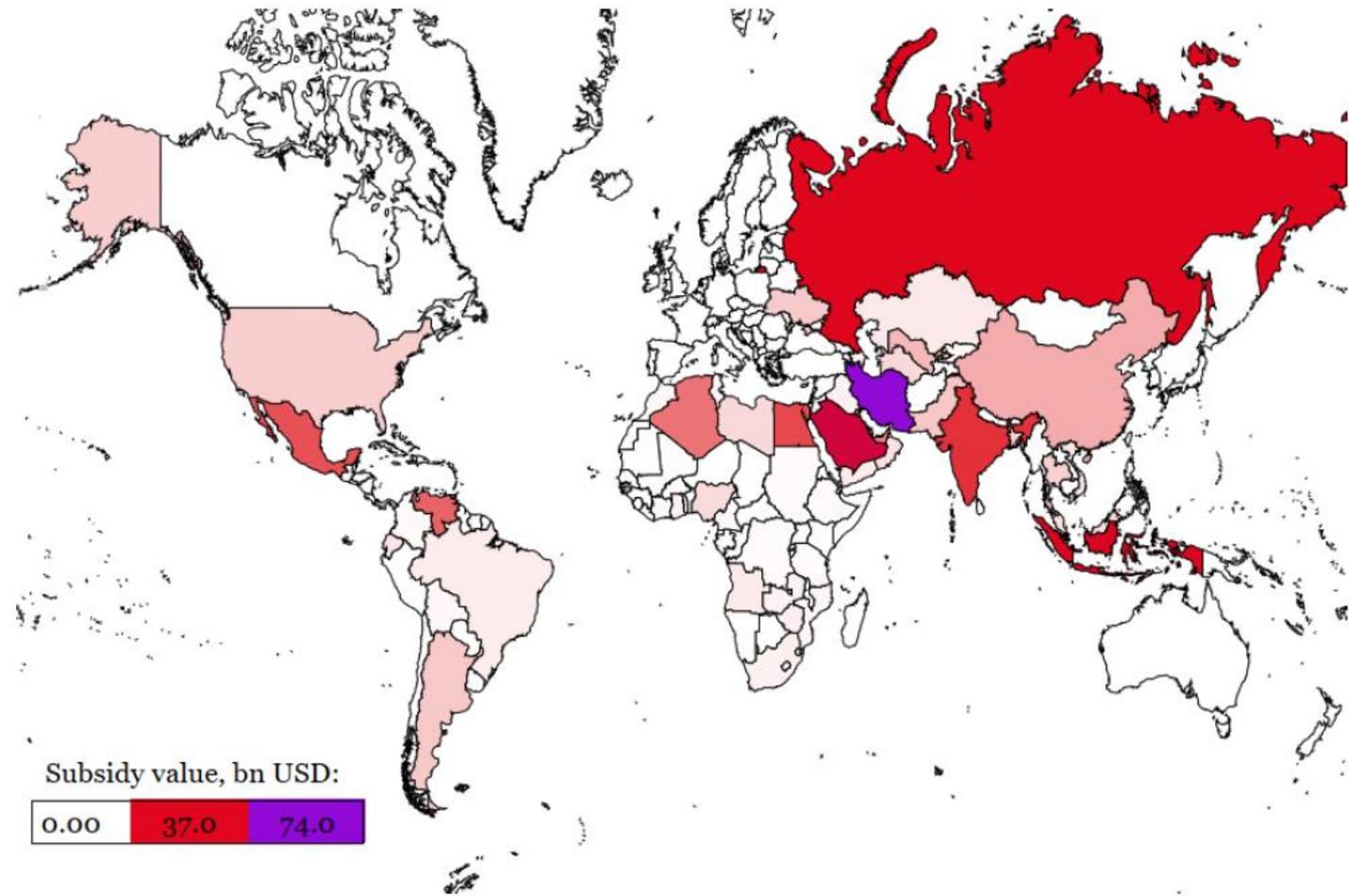
GTAP Water Database

- **Key data sources:** AQUASTAT, GTAP land use database, irrigated and rainfed crop areas, crop water requirement.
- **Data treatment:** crop sector in GTAP-Power is divided into irrigated and rainfed; water use is included into the cost structure of irrigated crops by river basin at the AEZ level.



GTAP Energy Subsidies Database

- **Key data sources:** IMF, IEA.
- **Data treatment:** Energy commodity market prices and tax rates are updated to represent the \$506 billion of fossil-fuel consumption subsidies in 2011.
- Coal, petroleum, natural gas and electricity subsidies are represented



Regional distribution of 2011 pre-tax fossil-fuel consumption subsidies.

Source: Chepeliev et al. (2018).

Source: Authors calculations based on IMF (2015) and using openheatmap.com.



Global Trade Analysis Project

GTAP Data Base and Satellite Accounts

Thank you!



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