Global Trade Analysis Project

Circular Economy Transition in the Eastern European Member States

Maksym Chepeliev,[1] Angel Aguiar,[1] Andrea Liverani,[2] Thomas Farole,[2] Dominique van der Mensbrugghe,[1] and Le (Allen) Wang[1]

[1]Center for Global Trade Analysis, Purdue University
[2]The World Bank

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Part 1:
Development of the GTAP Circular Economy Data Base (GTAP-CE)

1.1. Introduction

- **Current material use patterns are projected to put tremendous pressure on the Earth's ecosystem**
  - Changes in incomes and population together with a global convergence in material use patterns could result in over 2.5 times increase in global material demand by 2050 (Steffen et al., 2015).
  - These trends would represent a major challenge for the climate mitigation and other conservation efforts.
  - The need to move toward a more sustainable material consumption patterns is widely recognized and is promoted within a Circular Economy (CE) concept.
- **Modelling of the Circular Economy transition requires an explicit representation of the primary and secondary production activities**
  - Represent country-specific production volumes of primary and secondary activities.
  - Distinguish between corresponding supply and cost structures, e.g. for steel, aluminum, copper, other metals, plastics.
  - Such representation is not available in the standard GTAP Data Base.

1.2. Overview of the existing efforts

- **Number of studies have represented the Circular Economy splits within the global CGE or IO modelling framework**
  - MRIO assessments based on the EXIOBASE (e.g. Tisserant et al., 2017; Wiebe et al., 2019).
  - CGE-based assessment focusing on selected sector/commodity (e.g. Winning et al., 2017 for the case of steel).
  - GTAP-based assessments with a more detailed splits, e.g. OECD (2019), Dellink (2020), Bibas et al. (2021).
- **Selected limitations of the existing approaches:**
  - Are based on the EXIOBASE cost structures and output values, which do not always correspond to the actual observations (see e.g. Winning et al., 2017).
  - Focus on selected commodities or specific aggregate regional representations.
  - Are not consistently updated over time.
  - **Not publicly available.**

1.3. GTAP-CE sectoral splits

76 GTAP-Power 10 Data Base sectors are disaggregated into 95 sectors

No.	New sector	Sector description	GTAP sector code	Description
1	nmn	Non-metallic minerals mining	oxt	Other extraction
2	mio	Mining of iron ores		
3	mao	Mining of aluminum ores		
4	mco	Mining of copper ores		
5	moo	Mining of other ores		
6	rbr	Rubber products	rpp	Rubber and plastic products
7	plp	Plastic products – primary		
8	pls	Plastic products – secondary		
9	plr	Recyling - plastics		
10	isp	Iron and steel – primary	i_s	Ferrous metals
11	iss	Iron and steel – secondary		
12	ris	Recycling - iron and steel		
13	isc	Iron and steel casting		
14	app	Aluminum – primary	nfm	Non-ferrous metals
15	aps	Aluminum – secondary		
16	ral	Recycling - aluminum		
17	cpp	Copper – primary		
18	cps	Copper – secondary		
19	rcp	Recycling - copper		
20	mpp	Other metals – primary		
21	mps	Other metals – secondary		
22	rom	Recycling - other metals		
23	nfc	Non-ferrous metals casting		

1.4. Database construction steps

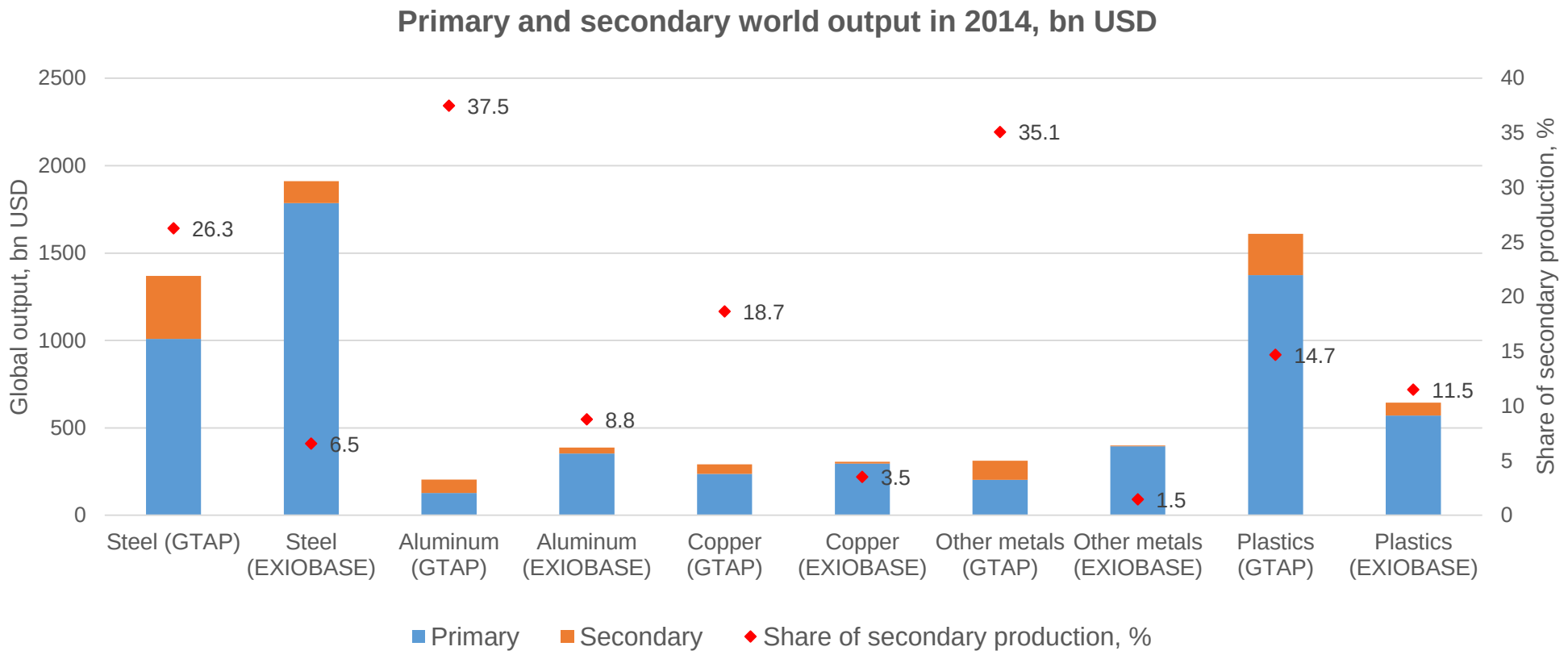
(1) Data preparation (output splits)	• ***Data:*** Volumes of primary and secondary production, volumes of waste, recycling rates, bilateral trade data for sectors or interest. • ***Data sources:*** USGS, UNIDO, BACI, UNEP IRP MFA, PRODCOM, World Steel, Jambeck et al. (2015), Plastics Europe, Veolia, multiple country-specific data sources (for plastic recycling rates). • Construction of the production targets using volume and price data.
(2) Data preparation (supply/use splits)	• ***Data:*** Disaggregated individual country input-output tables (USA, Korea, Japan, Canada), EXIOBASE, specific cost structure assumptions. • Construction of the cost structure targets.
(3) Targets' reconciliation	• ***Data:*** GTAP 10 Power Data Base, data inputs from Steps 1 and 2. • Reconciliation of the production targets, supply/use structures and trade data for disaggregated SAMs extracted from the GTAP.
(4) Database split	• ***Data:*** Split targets from Step 3. • GTAP Data Base split using SPLITCOM. Further refinement using GTAPAdjust if relevant.
(5) Construction of the final database	• ***Data:*** Disaggregated database from Step 4. • Incorporation of the energy and emission flows for disaggregated sectors. Compilation of the final database.

1.5. Selected challenges

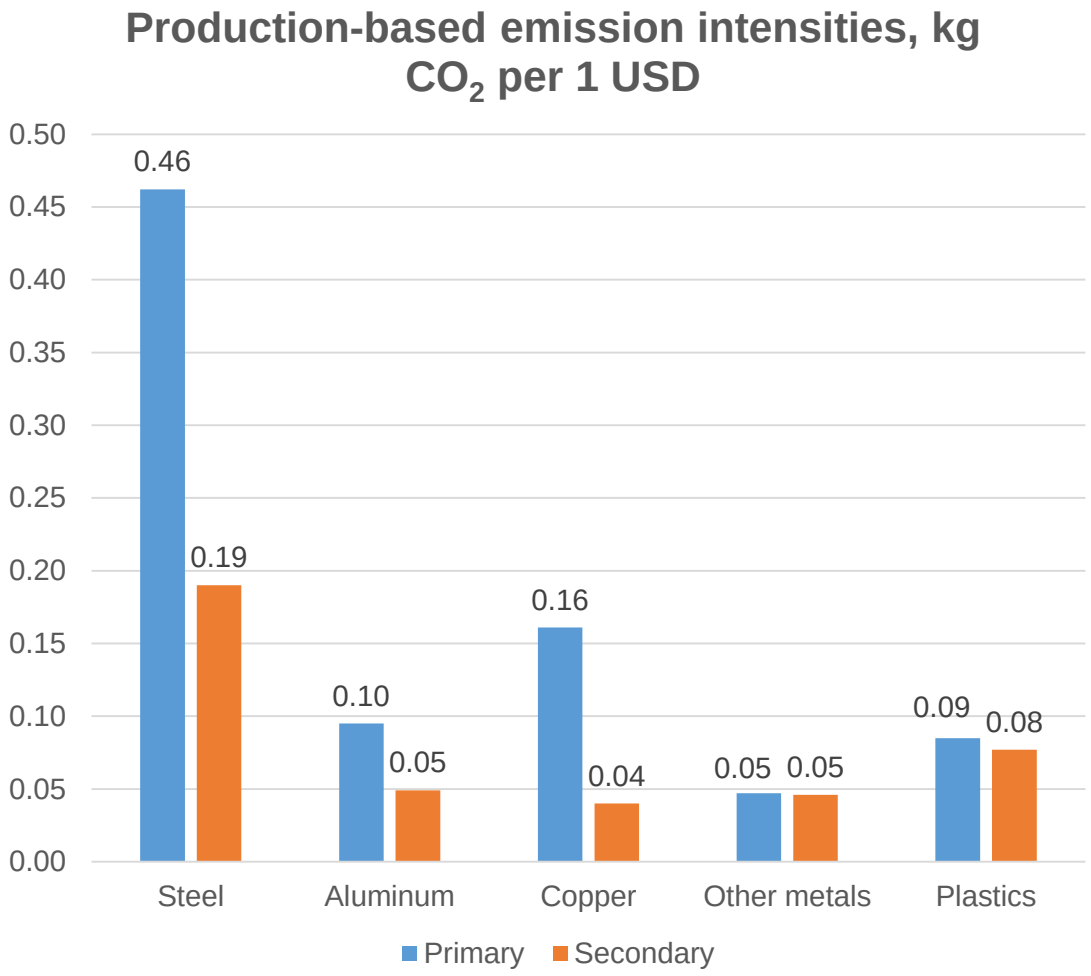
- **Inconsistencies between trade, output and underlying GTAP data** -> need to adjust other sectors in GTAP for a more precise targeting.
- **Value of output and intermediate supply of the GTAP 'wtr' sector** (includes waste management) **is much lower than targeted values** of scrap and recycled waste for almost all countries -> disaggregated recycling from the corresponding primary sector.
- **Not all supply/use structures are available** (e.g. recycling or secondary production) -> potential for further refinement.
- Use trade-based prices to derive output values targets, which are then scaled to the GTAP totals -> might use **domestic country-specific prices**, if available.
- Lacking explicit representation of the **country-specific sources of scrap/waste** by sectors and agents.

1.6. Comparisons with EXIOBASE

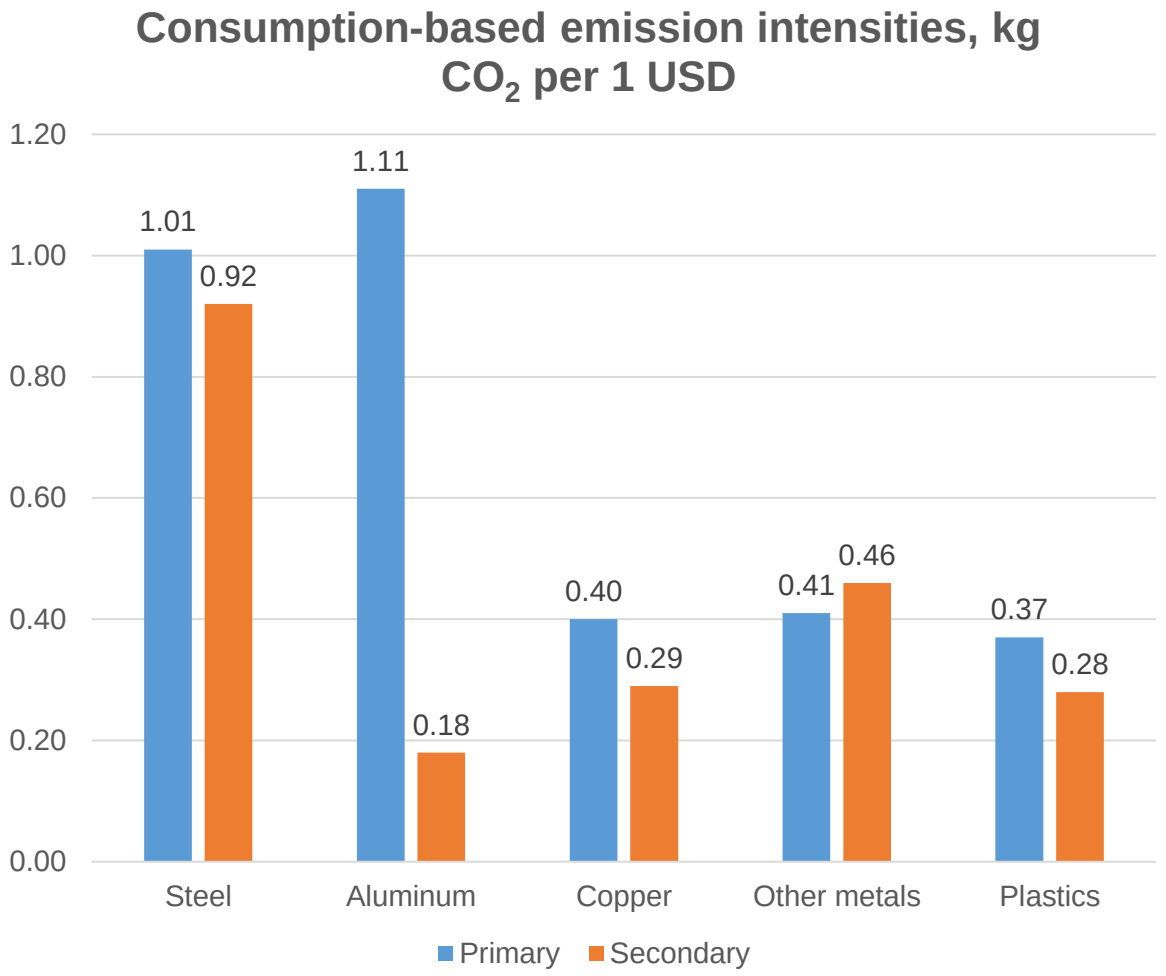
- While **EXIOBASE** is a rich source of information, it **should be used with** quite a bit of **caution**:
  - Reporting 163 sectors, it aggregates some CE-related splits (e.g. casting, plastics and rubber, etc.). No explicit representation of waste/scrap processing. Limited regional coverage – 49 (mostly OECD).
  - Reports cases of negative value added (salary, capital returns), consumption or output. It might be consistent with actual IOTs, but not 'appreciated' by CGE models.
  - Some output values and cost structures are not always plausible.



1.7. Overview of the GTAP-CE: Emission intensities



Global average estimates

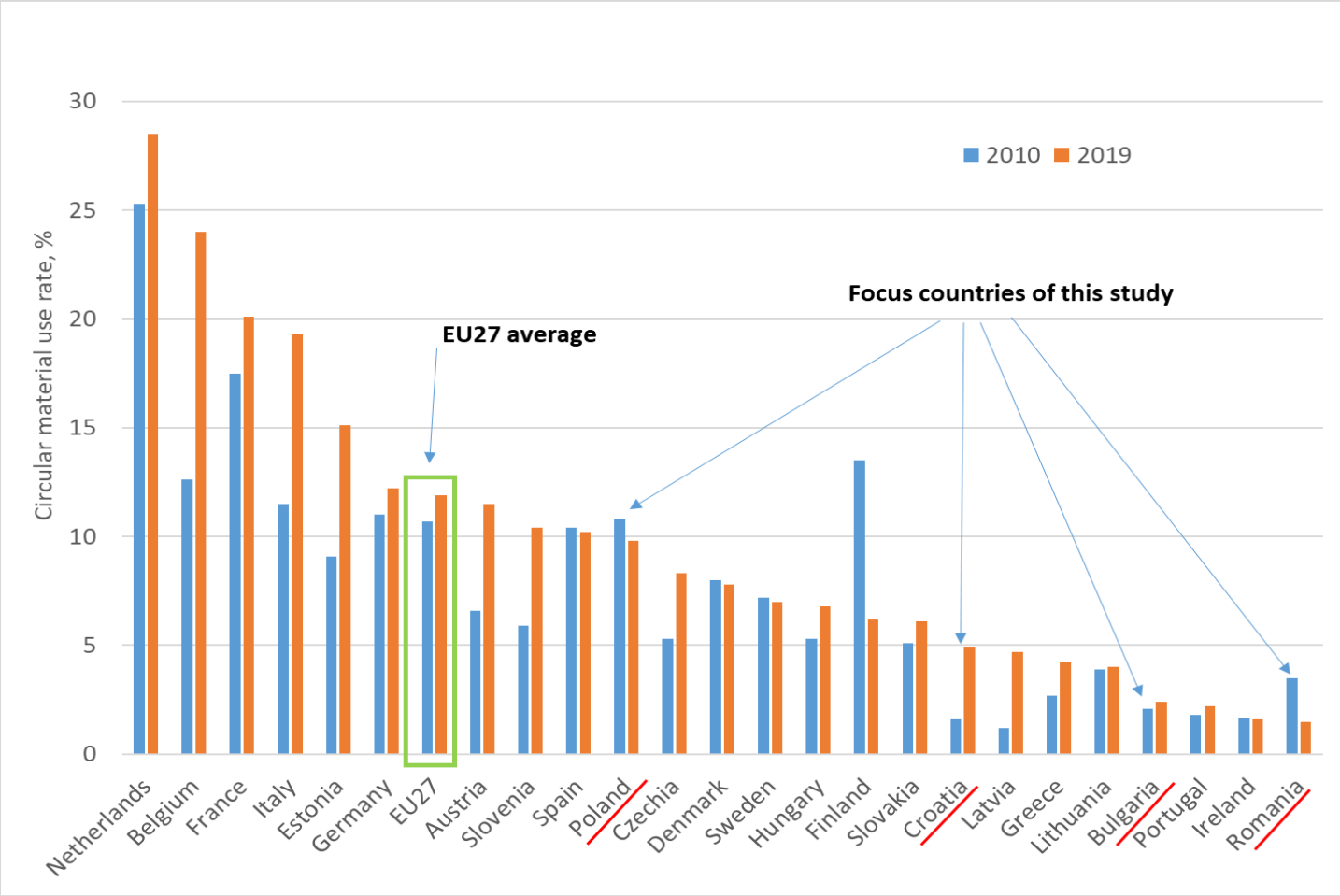


Global average estimates

Part 2:
Circularity in the Eastern European Member States

2.1. EU circular economy initiatives

- In 2015 the European Commission has adopted the first Circular Economy Action Plan.
- CE Action plan was updated in 2020 – one of the main blocks of the European Green Deal.
- The level of efforts toward CE transition at the EU country level is something decided by national and subnational governments.

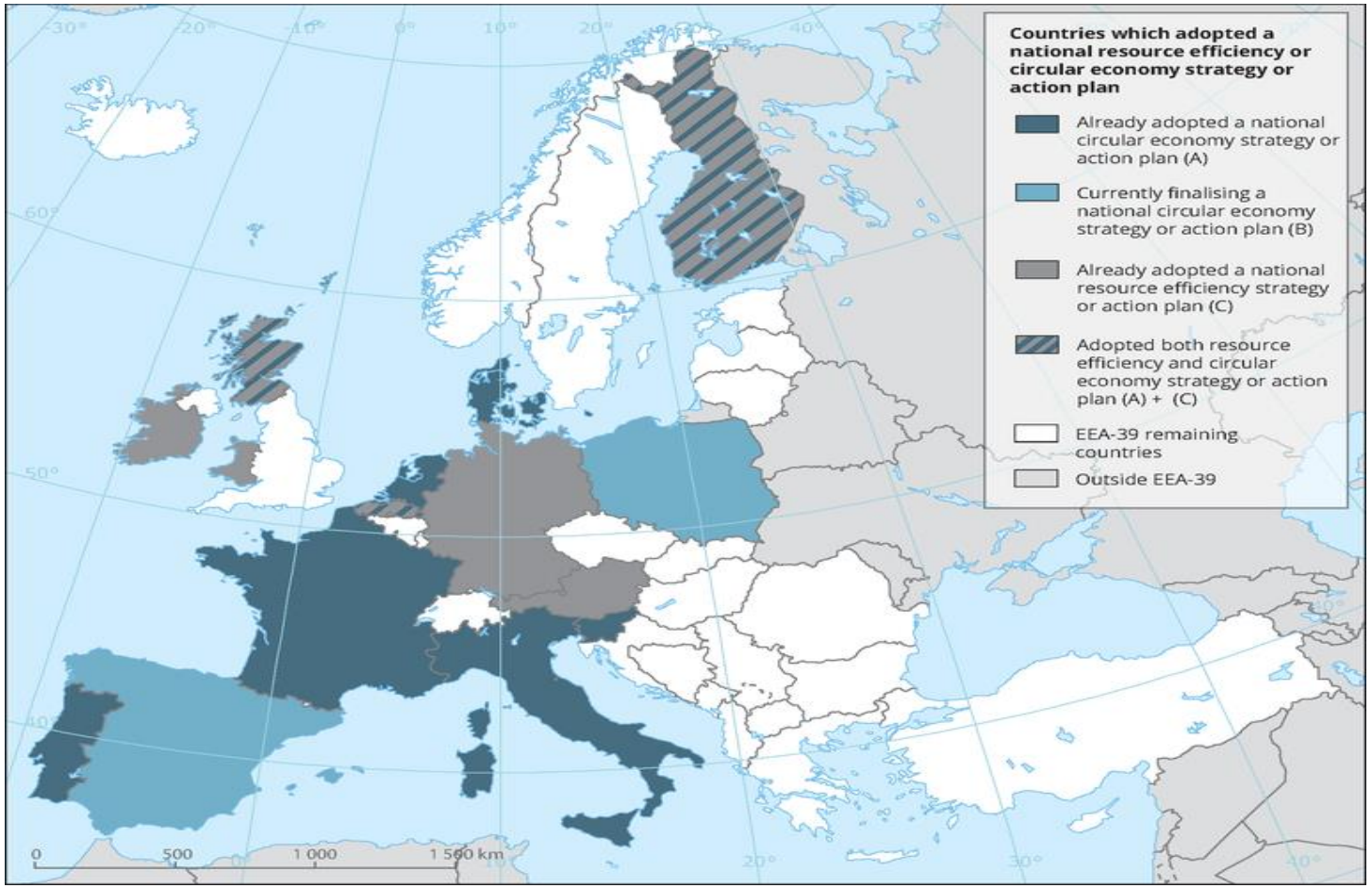


Circular material use rate in the selected EU countries in 2010 and 2019, %

Notes: The indicator measures the share of material recovered and fed back into the economy - thus saving extraction of primary raw materials - in overall material use.
Source: EC (2020b).

2.2. EU circular economy initiatives

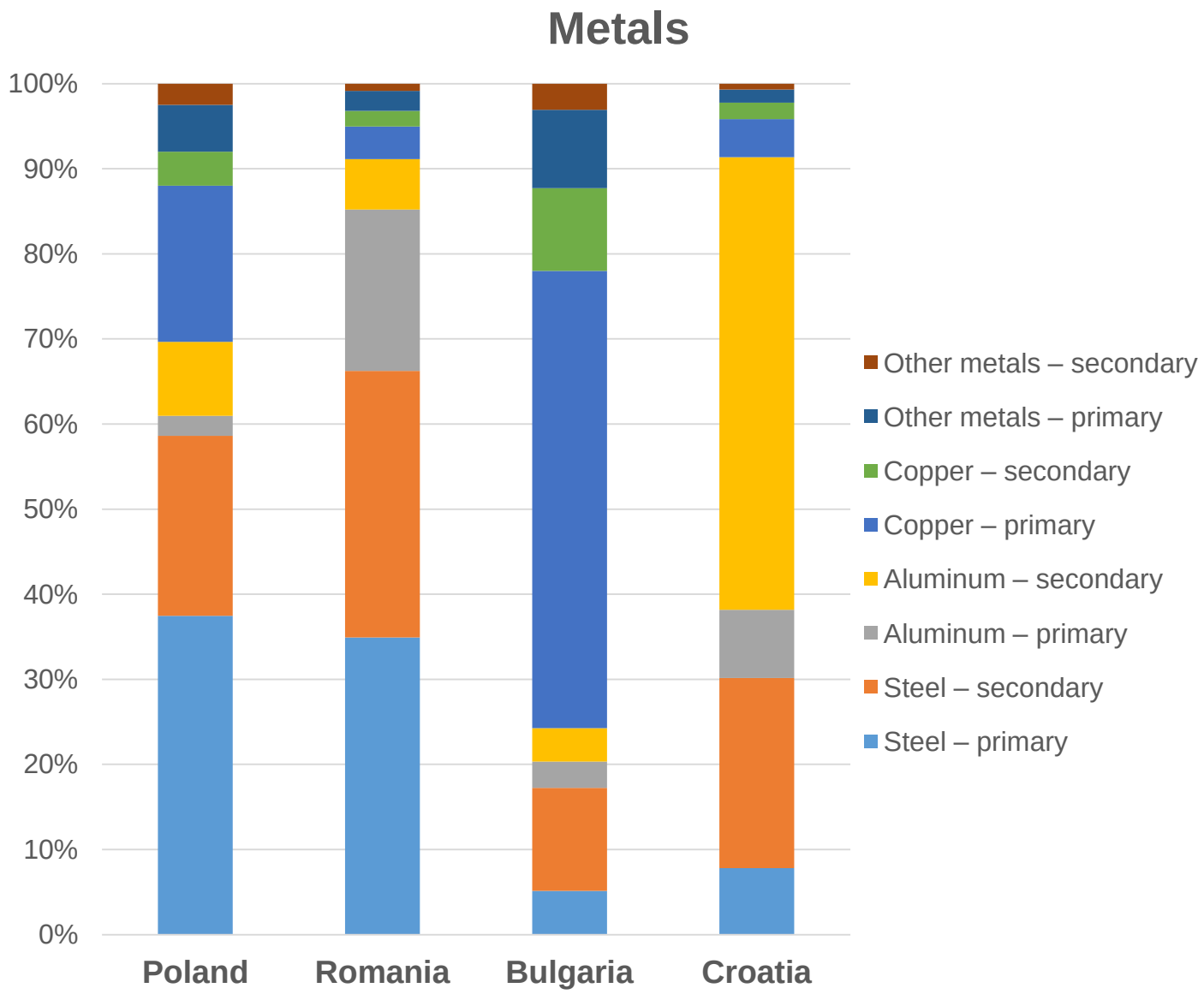
- So far, only a handful of EU countries have adopted national resource efficiency or circular economy strategies/action plans.
- Policy makers are not always well equipped with the sufficient knowledge of the circularity principles and potential impacts of the CE policies on the economy (Domenech and Bahn-Walkowiak, 2019).

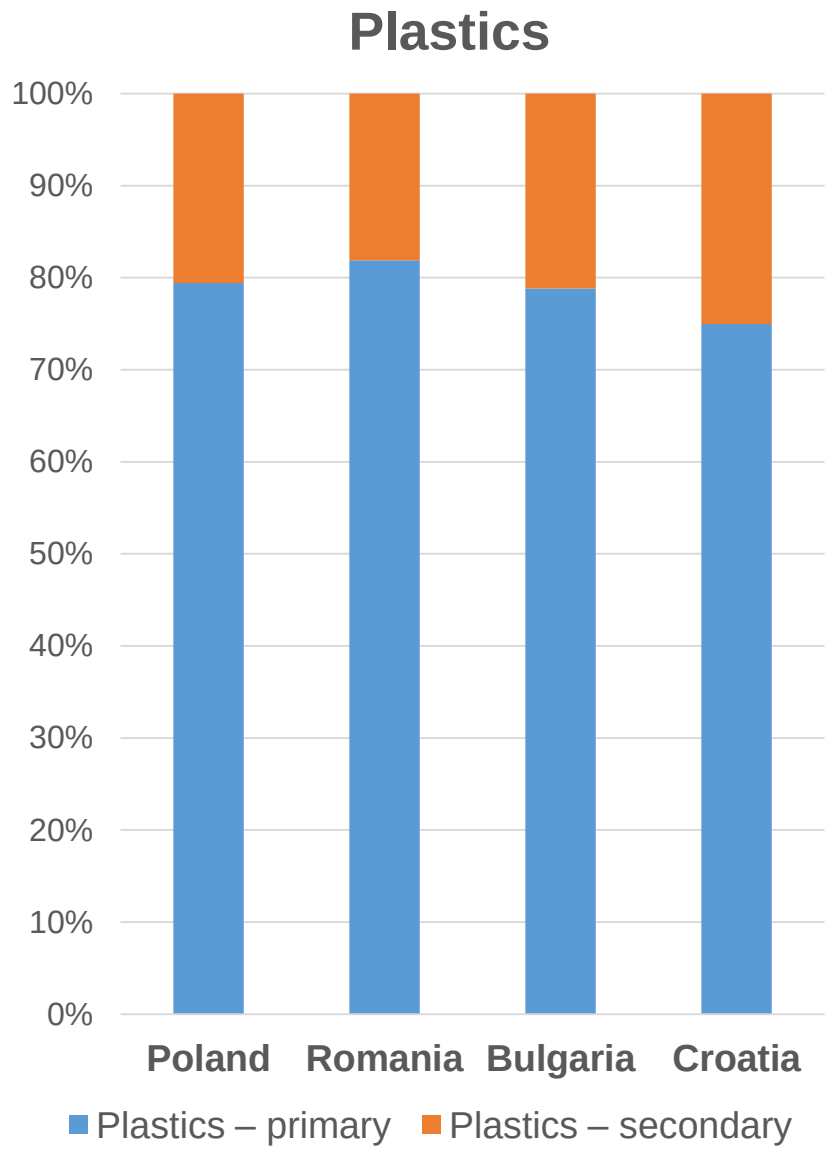


Circular economy strategies or action plans adoption status

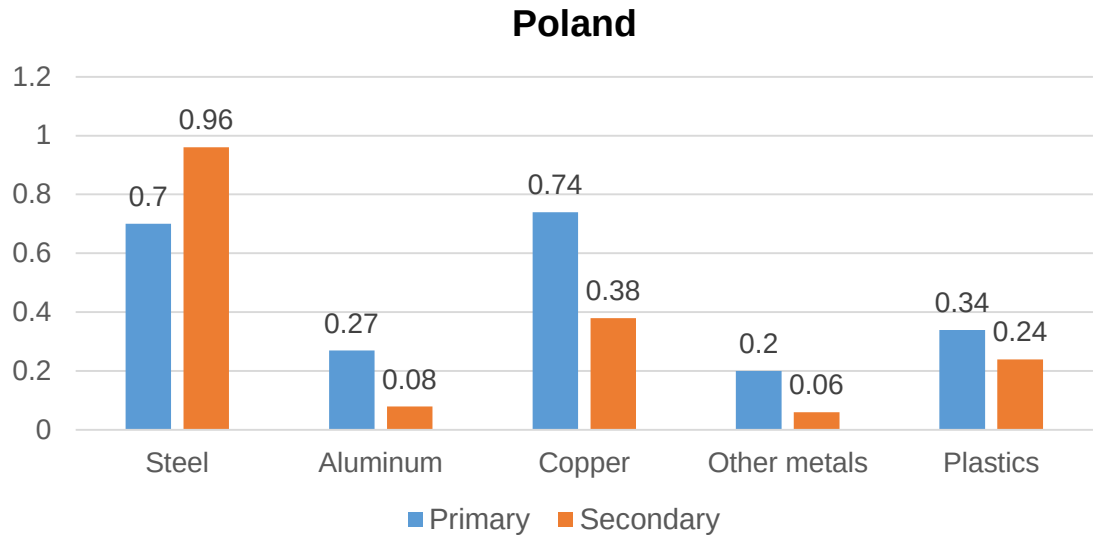
Source: EEA (2020).

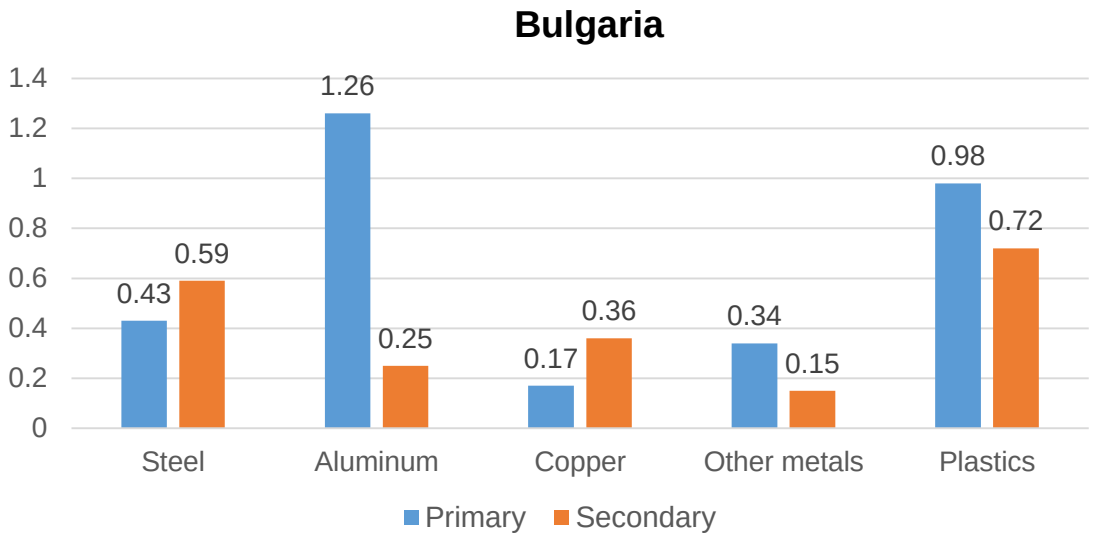
2.3. Primary and secondary output composition

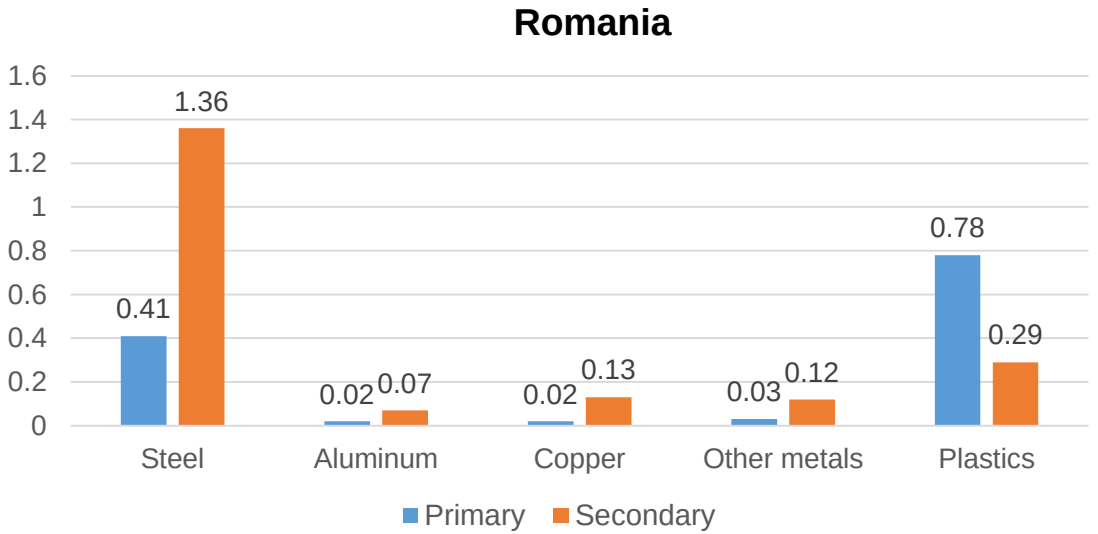


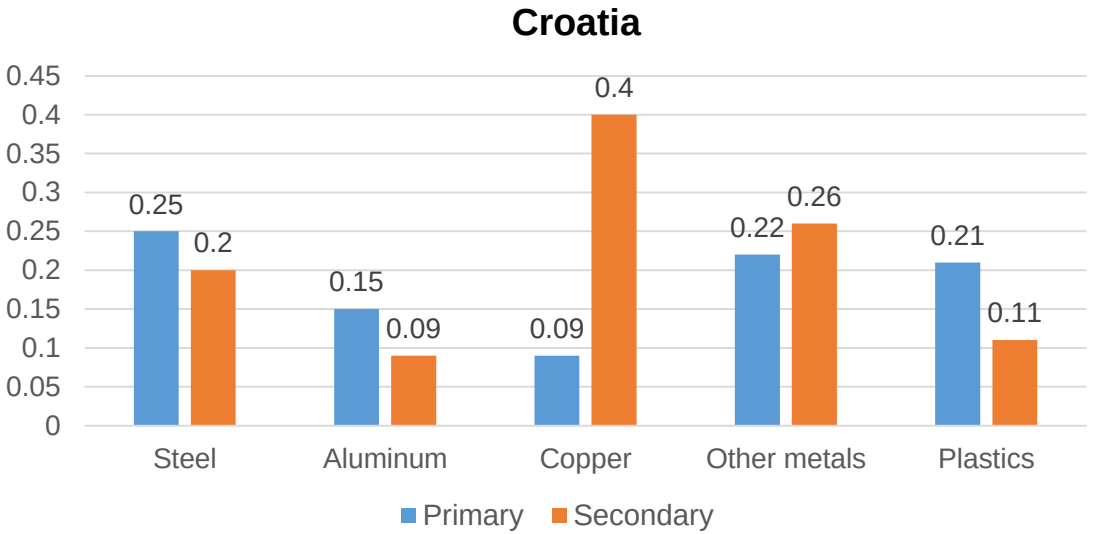


2.4. Consumption-based emission intensities, kg/USD









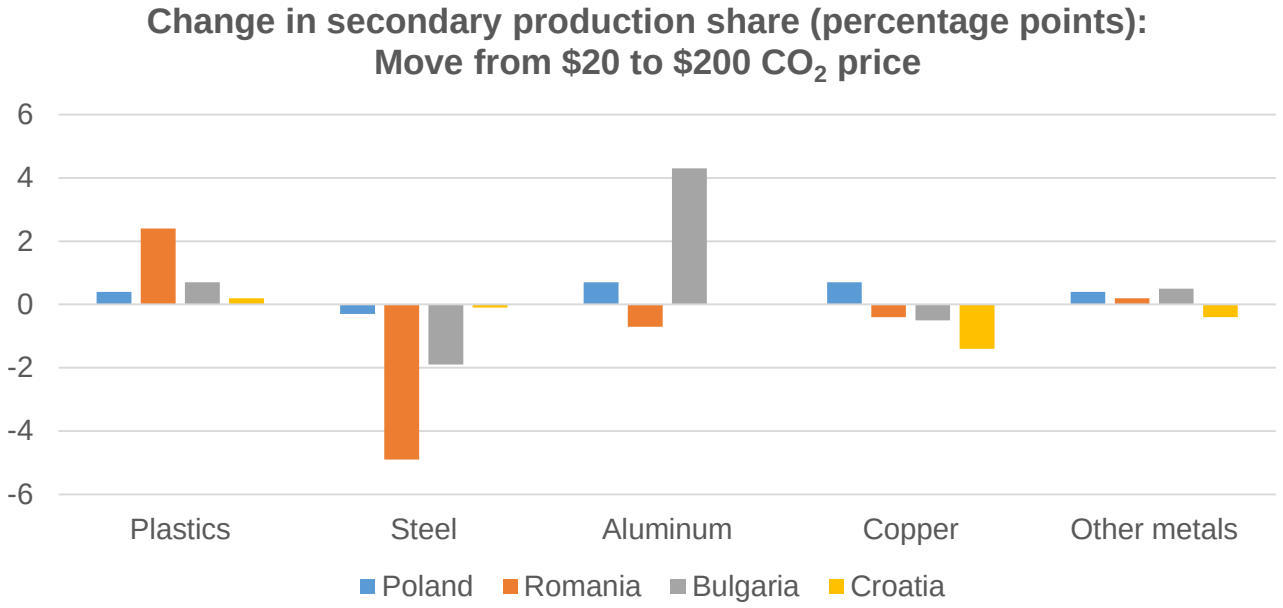
Cost structures suggest that in some country cases **secondary production** has **a higher share of electricity** input **than** the **primary activity**

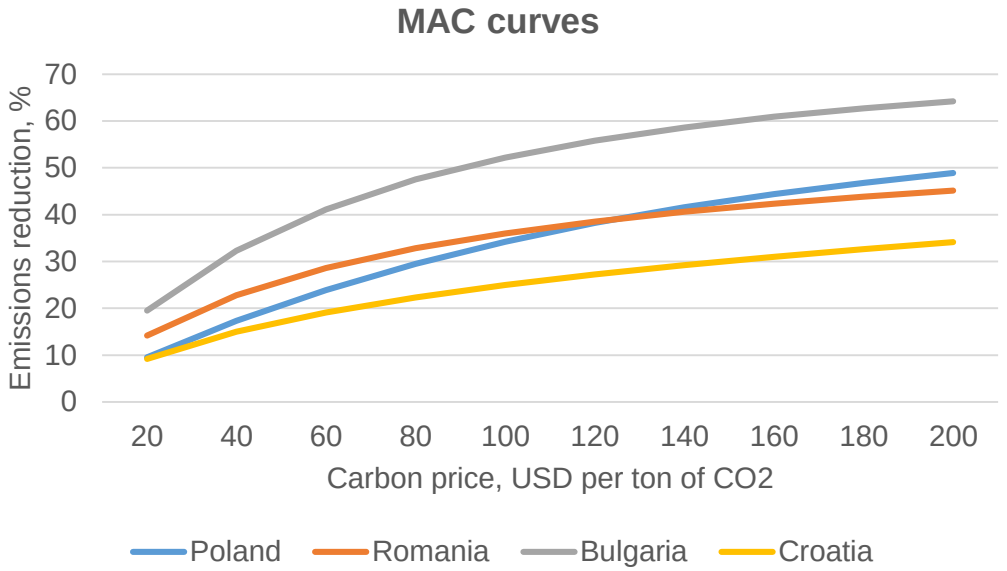
2.5. Preliminary modelling assessment

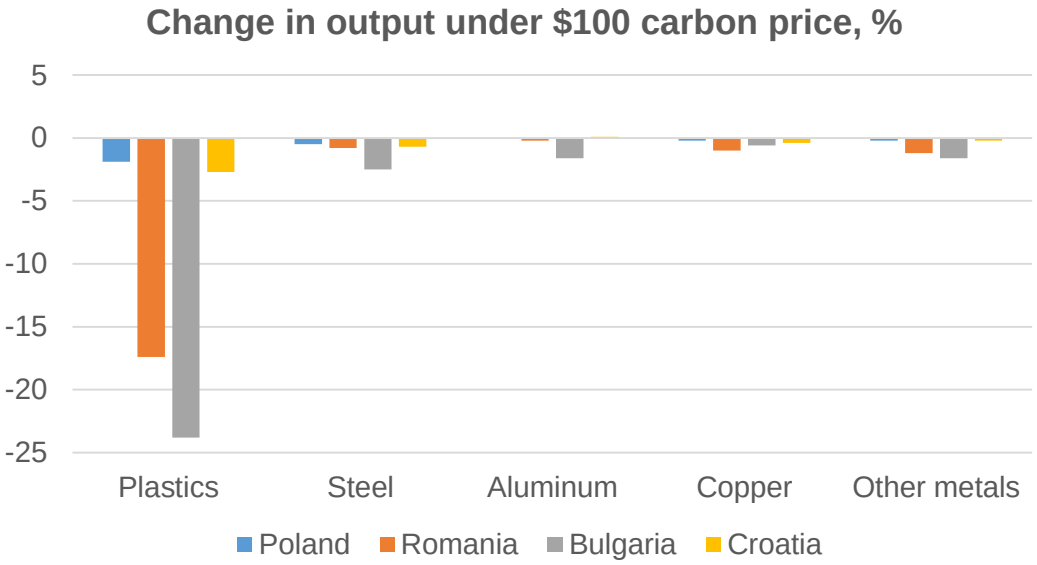
- **Static ENVISAGE CGE model**.
- GTAP-CE Data Base is aggregated to **42 activities, 30 commodities** and **20 regions**.
- **Primary and secondary activities are producing homogenous commodity, same for electricity generation.**
- **Three sets of scenarios:**

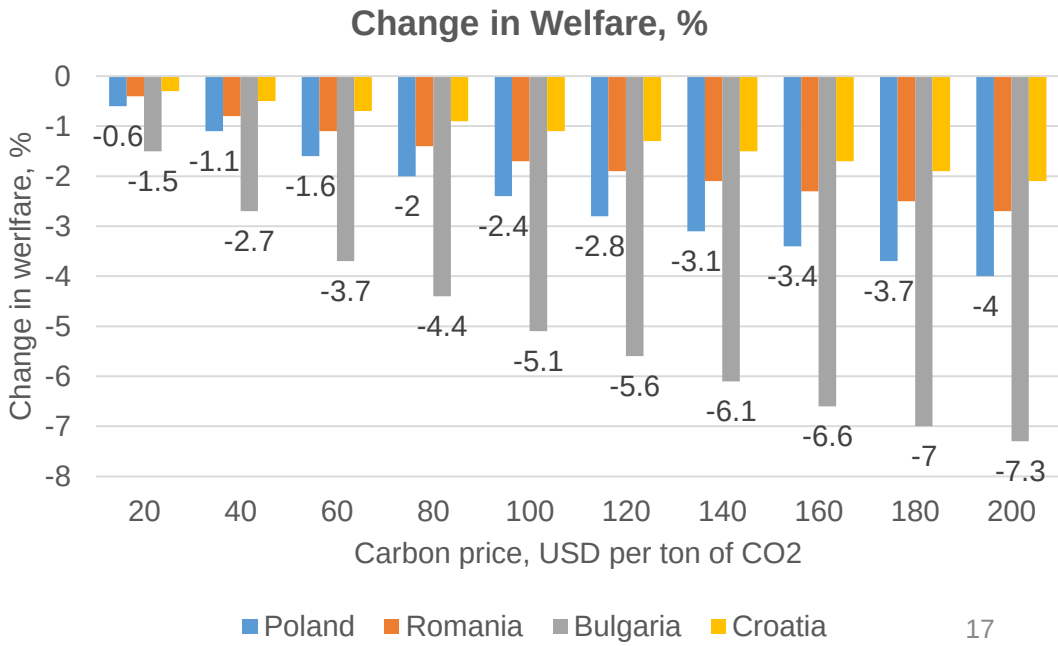
  1) **EU-wide carbon price** ranging from $20 to $200 per tCO_2 at $20 increment.
  2) **EU-wide subsidy to secondary production** activities (steel, aluminum, copper and other metals) ranging from 5% to 40% at 5% increment.
  3) **Subsidy to secondary production (5%-40%) + $100 carbon price** (discussed but not reported in this presentation).

2.6. Impacts of carbon pricing

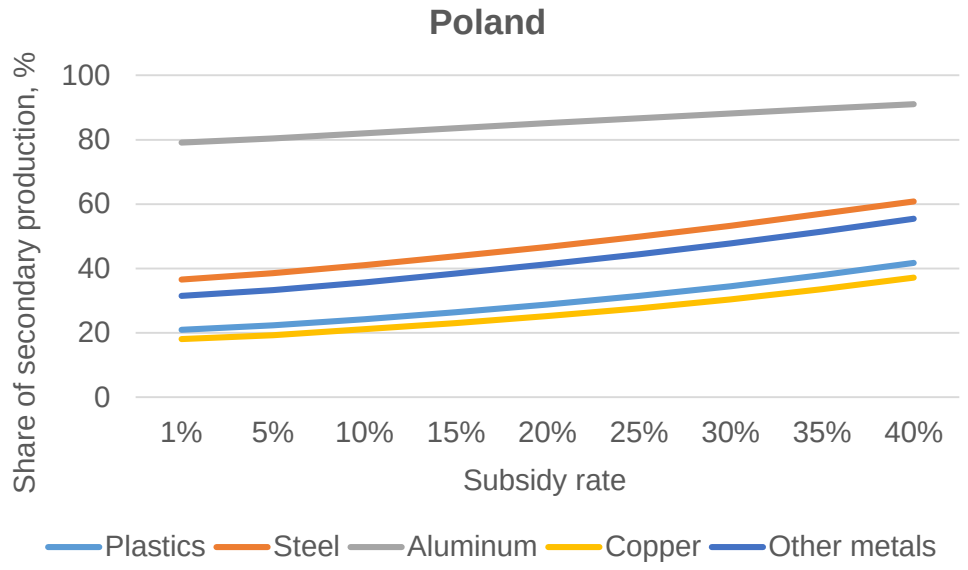


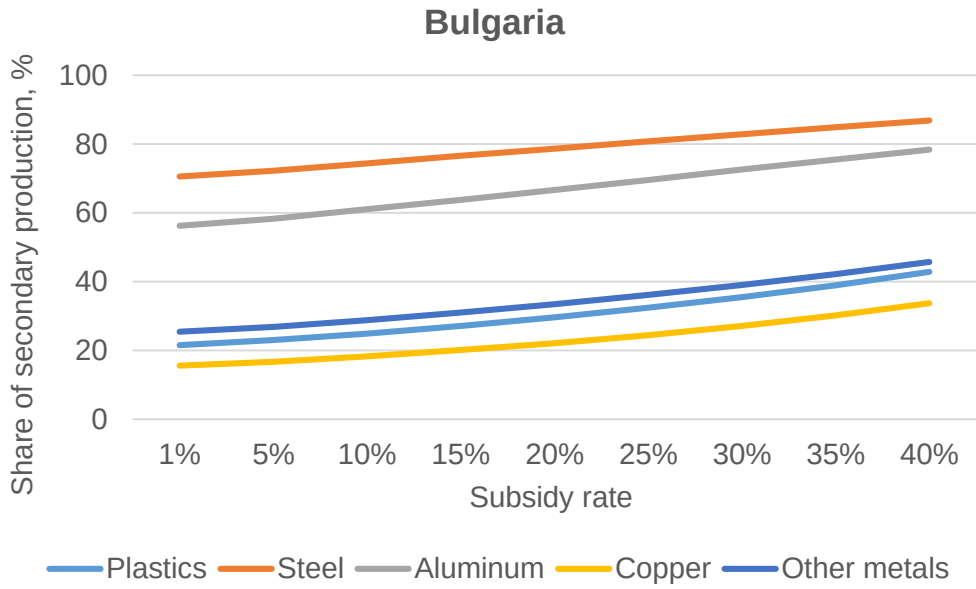


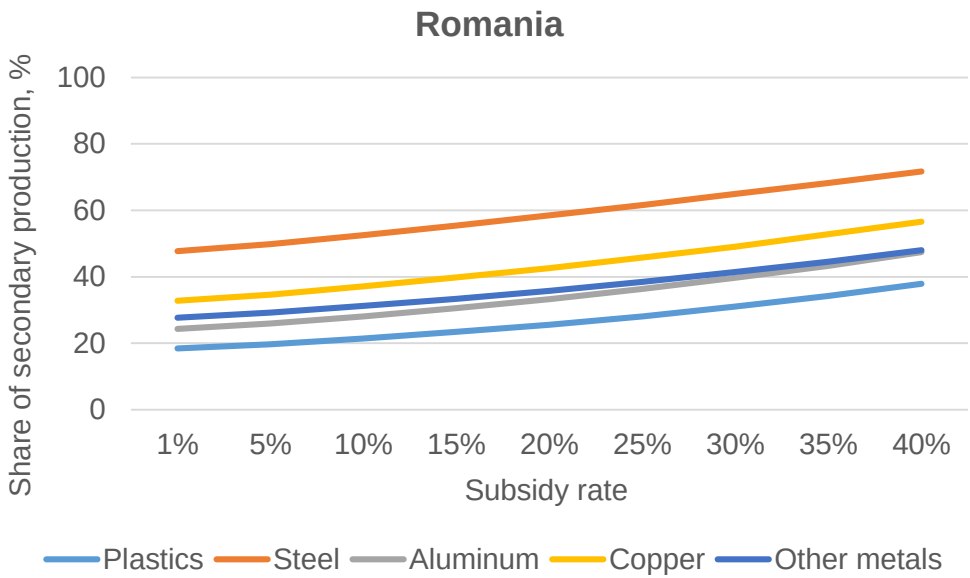


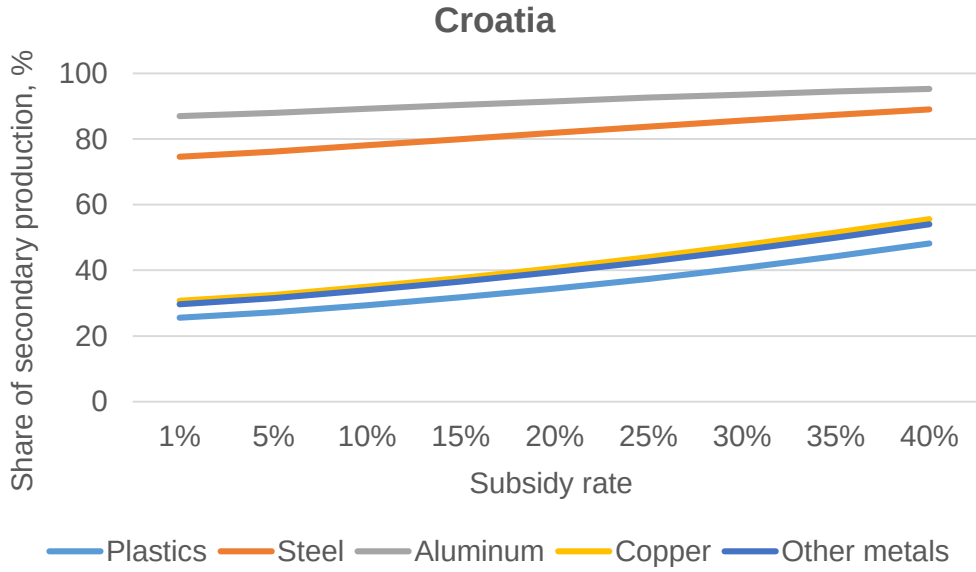


2.7. Subsidy to secondary production (1)

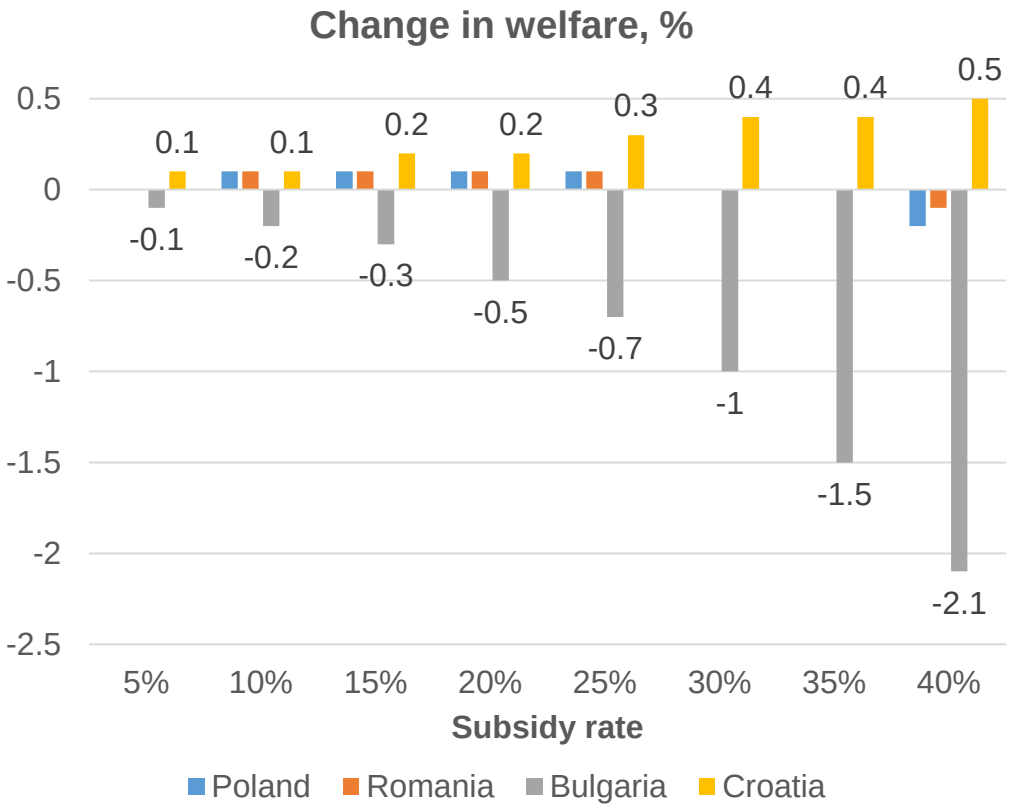


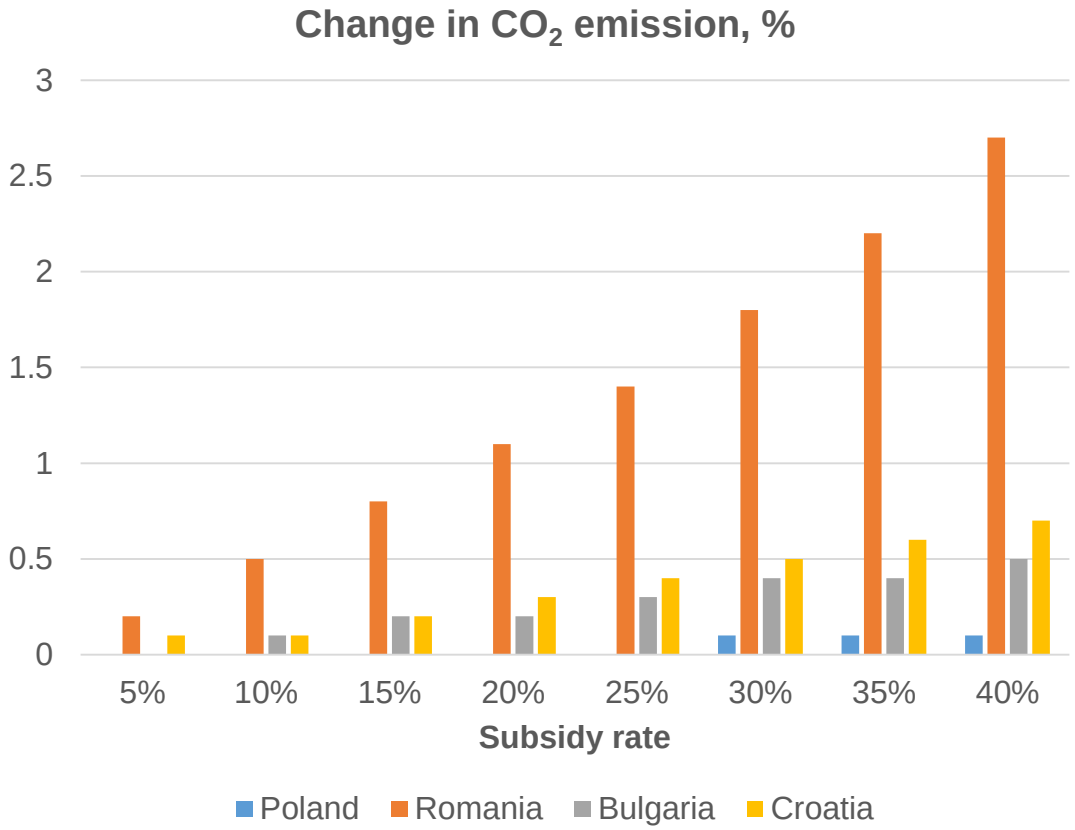






2.8. Subsidy to secondary production (2)





- **Carbon pricing** -> efficient in abating CO_2 and reducing overall material demand, but minor impact on recycling
- **Subsidy to secondary production** -> minor (negative) impact on CO_2 emissions
- Based on additional simulations, **combination of carbon pricing and subsidy to recycling** results in almost **additive effects** from the two sets of measures

3. Next steps

GTAP circular economy database:

- Is a first attempt to split primary and secondary production processes for selected activities (metals and plastics).

Data side (next steps):

- Further refinement of cost structures and balancing techniques.
- Develop a special release of the GTAP-CE 10 Data Base.

• Modelling side (next steps):

- Dynamic baseline + policy simulations: EU Green Deal climate mitigation.
- Assessment of the specific CE-related policy measures in the countries of interest.

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Thank you!
Questions/Comments?

mchepeli@purdue.edu

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