



DYNAMIX

Decoupling growth from resource use
and its environmental impacts

"Quantitative and qualitative assessment of policies for decoupling growth from resource use and its environmental impacts - results from the Dynamix project"

Andrea Bigano, Francesco Bosello

FEEM and CMCC

Fabio Eboli

MATTM

Jacopo Zotti

Università di Trieste

27 October 2016, FEEM-IEFE Joint Seminar
FEEM- Milano



DYNAMIX is a project funded
under the European Union
Seventh Framework Programme



OUTLINE

- Introduction
- The project's features and objectives
- Quantitative Analysis
- Qualitative Analysis
- Conclusions



DYNAMIX

Decoupling growth from resource use
and its environmental impacts

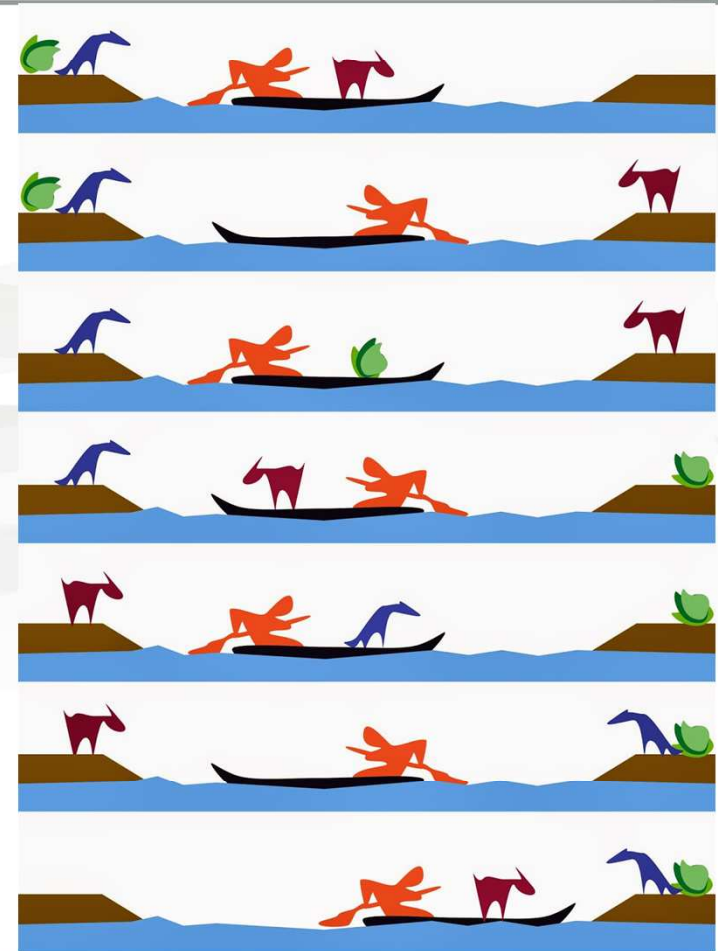
Propositio de lupo et capra et fasciculo cauli:

*Homo quidam debebat ultra fluvium transferre lupum et
capram et fasciculum cauli, et non potuit aliam navem
invenire, nisi quae duos tantum ex ipsis ferre valebat.
Praeceptum itaque ei fuerat, ut omnia haec ultra omnino
illaesa transferret. Dicat, qui potest, quomodo eos illaesos
ultra transferre potuit.*

Propositiones ad Acuendos Juvenes, Alcuin of York (IX century)

...takes a while, but feasible!

...feasible at the global scale as well?





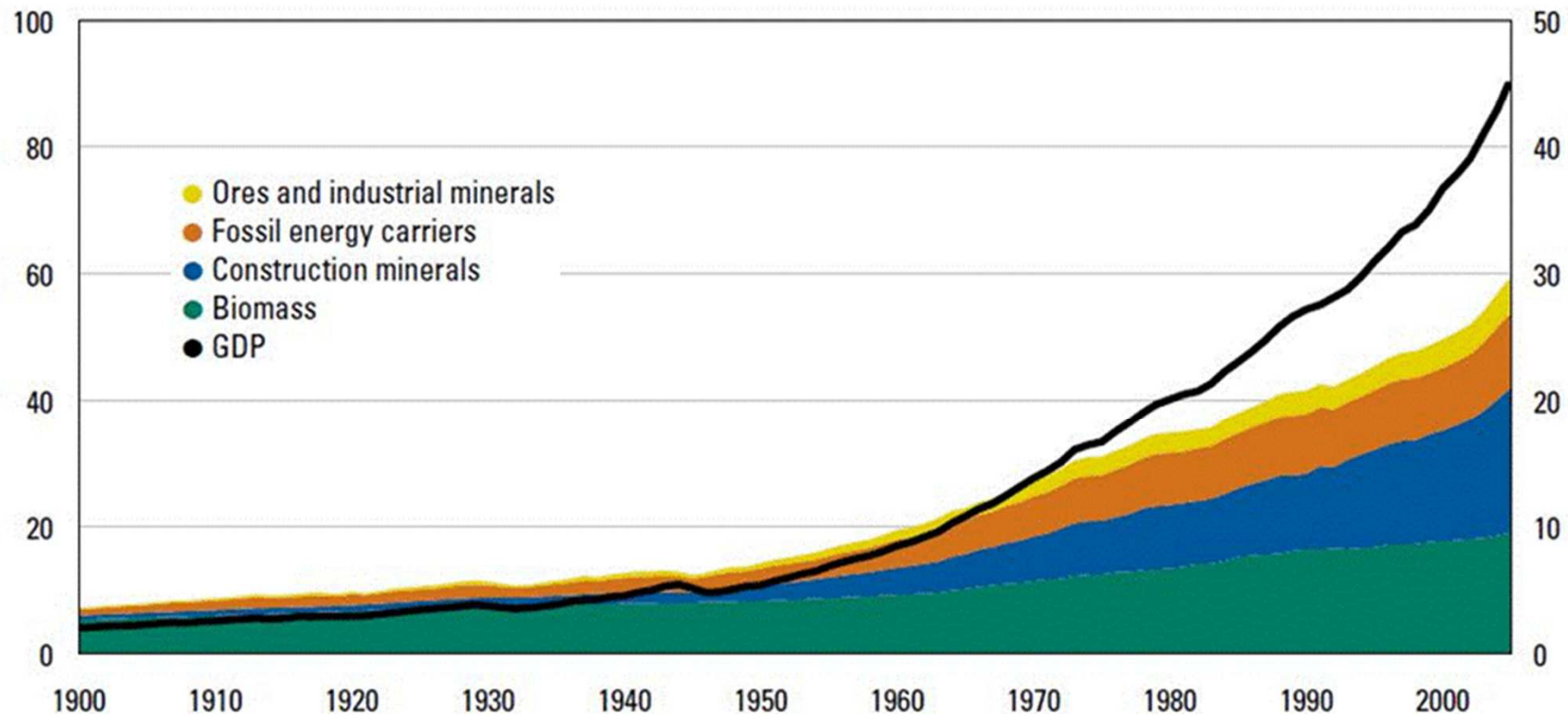


Material extraction

Billion tons

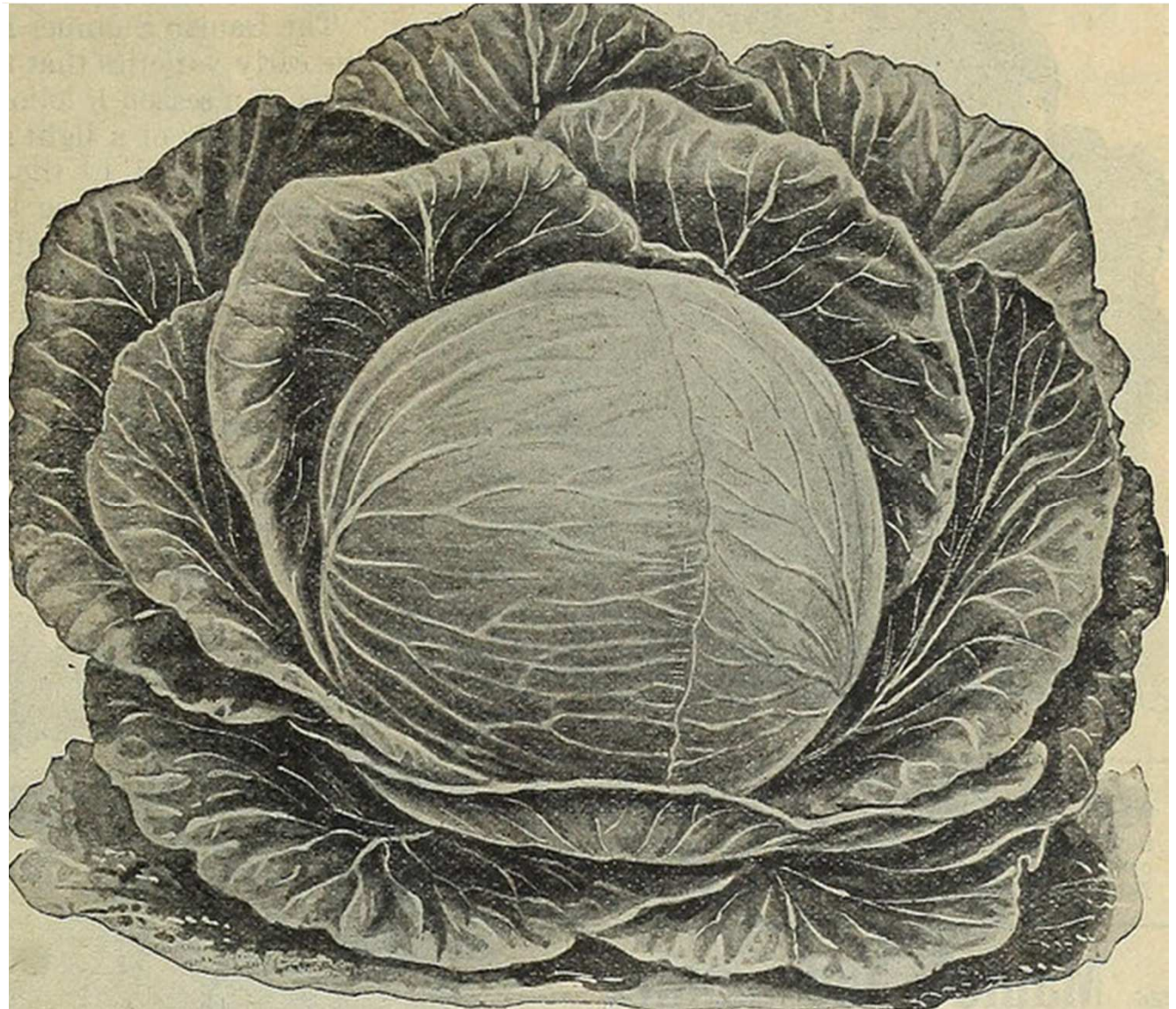
GDP

trillion (10^{12}) international dollars

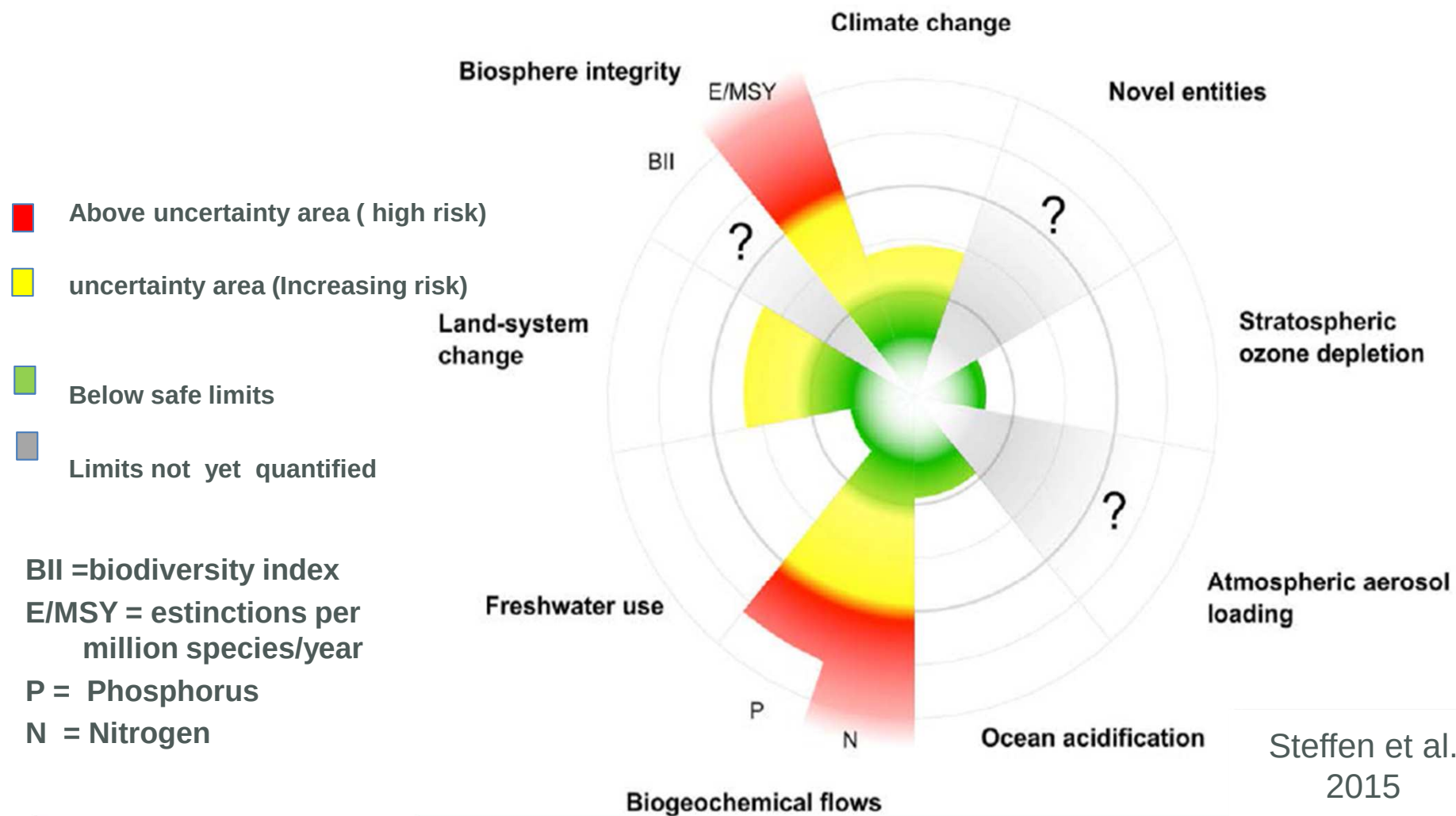


Global resources use, billion tons 1900 – 2005; Krausmann et al. 2009

THE LIMITS OF THE PLANET



THE LIMITS OF THE PLANET

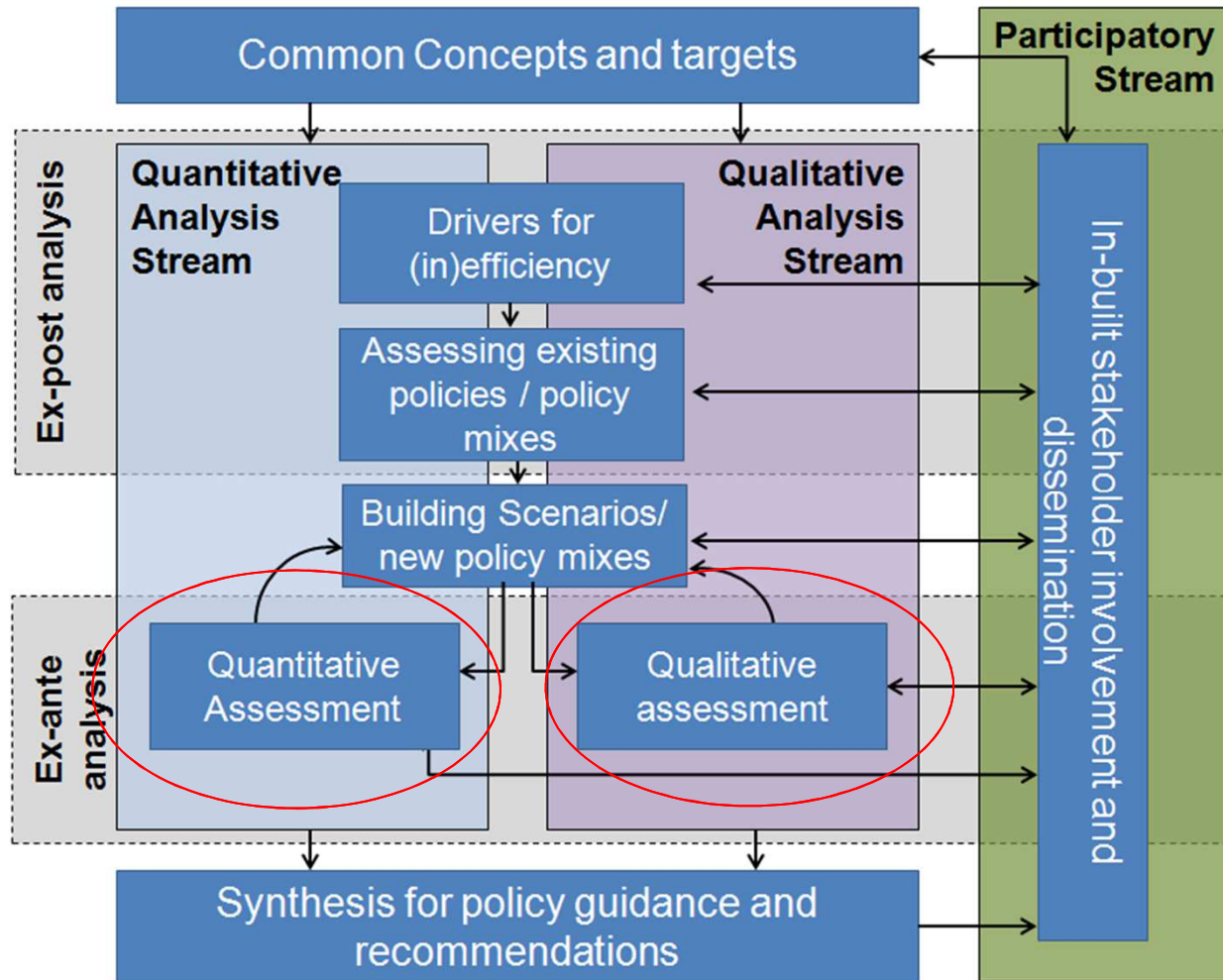


Steffen et al.
2015

WHAT HAS BEEN DYNAMIX ABOUT

- Identifying promising policy mixes for efficient resource use, based on key factors and lessons from the past
- Assessing environmental economic and social impacts for the medium (2030) and long run (2050)
- Involving stakeholders in the research process
- Providing an analytical framework for policy mix formulation
- Providing input for the process of drafting the Juncker Commission's Circular Economy Action Plan

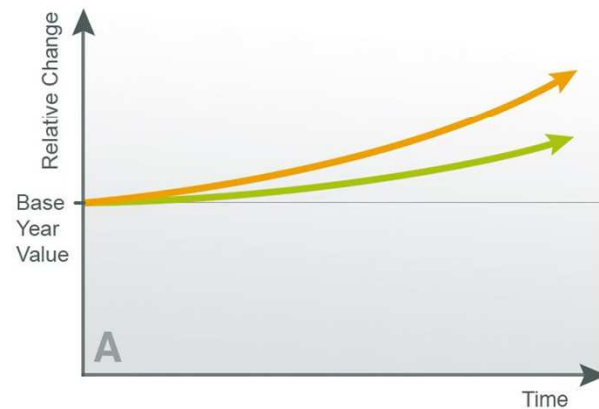
PROJECT LOGIC



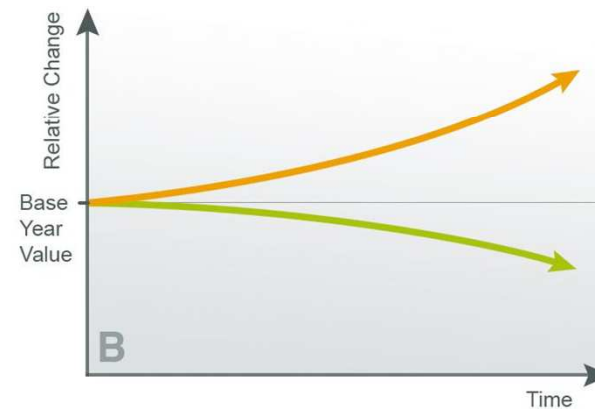
DYNAMIX APPROACH: DECOUPLING RESOURCE USE AND GROWTH

Conventional Decoupling

Relative Decoupling

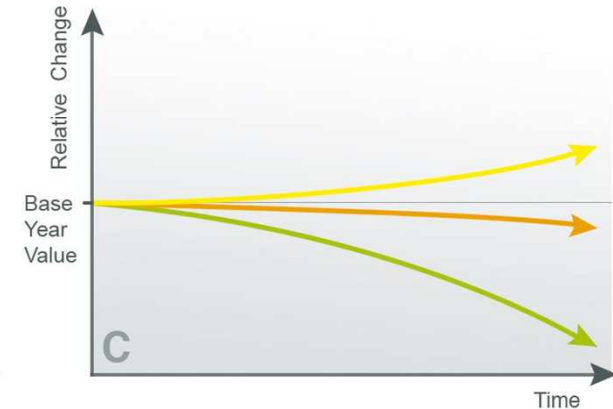


Absolute Decoupling



Reframing Decoupling

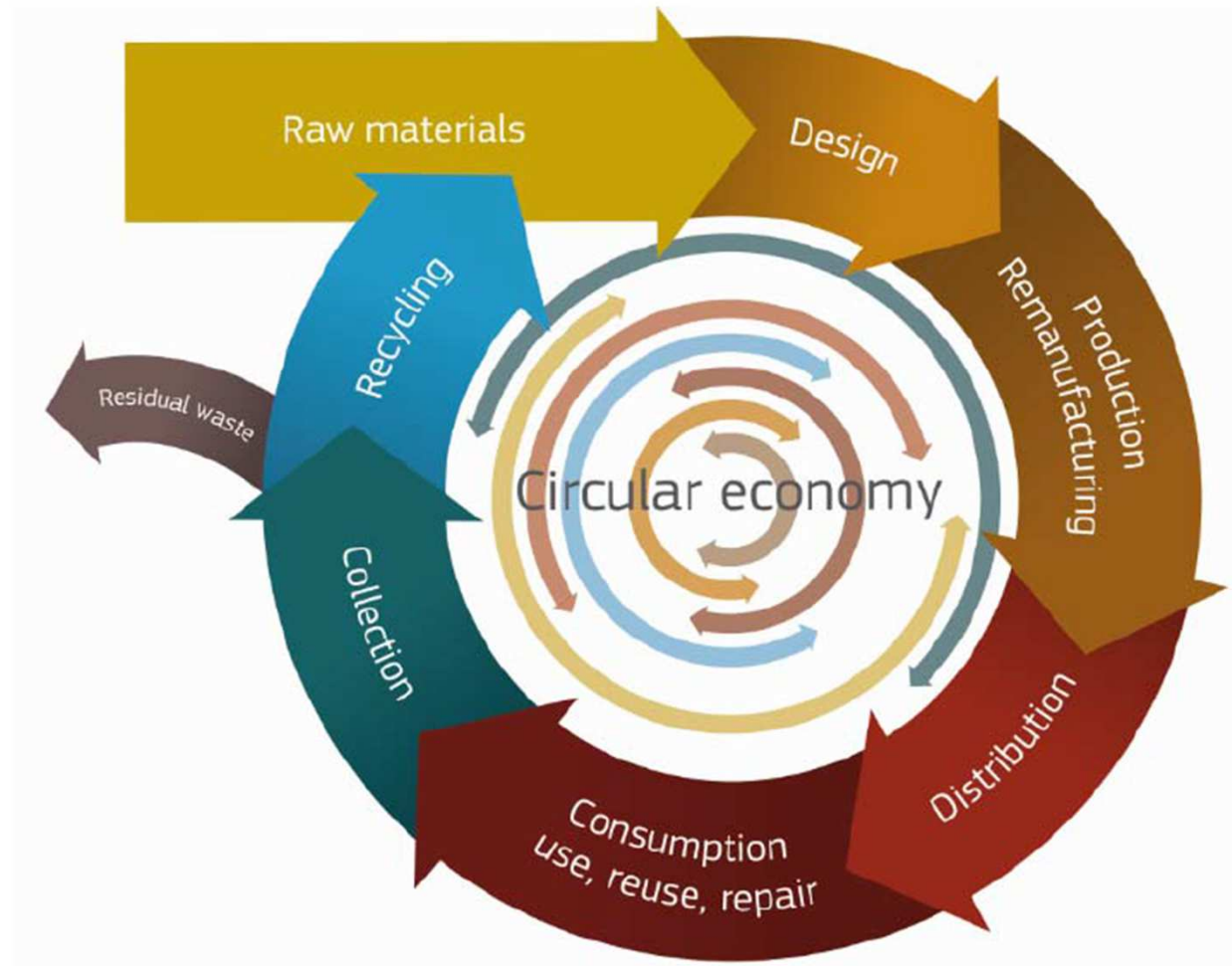
Absolute Decoupling of Resource Use from Wellbeing



- GDP
- Resource use/environmental impacts
- Welfare

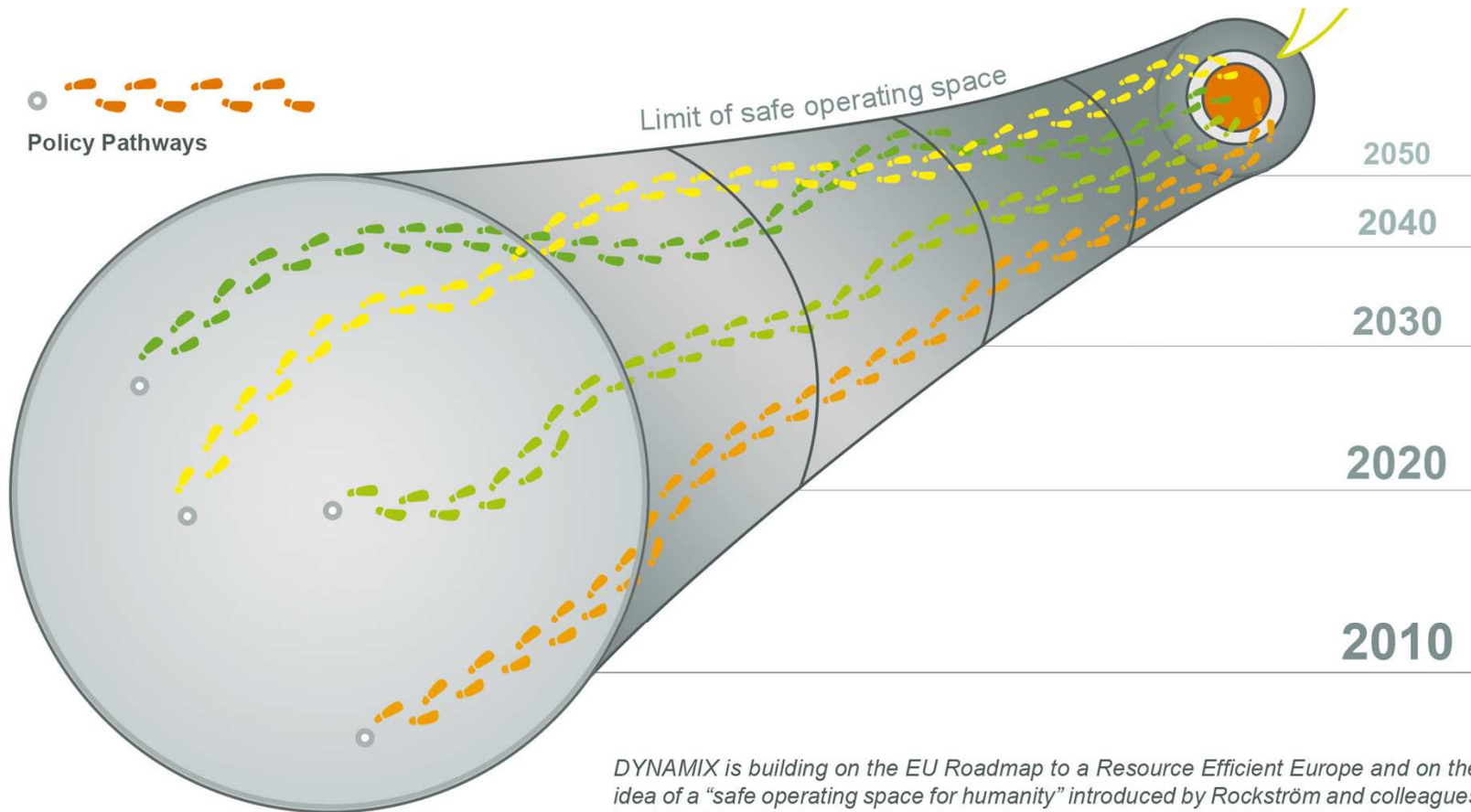
DYNAMIX APPROACH: CIRCULAR ECONOMY

- Whole life cycle
- “Close the circle”



European Commission 2014

DYNAMIX APPROACH: POLICY MIXES AND PATHWAYS



DYNAMIX is building on the EU Roadmap to a Resource Efficient Europe and on the idea of a "safe operating space for humanity" introduced by Rockström and colleagues in 2009. Visualisation is adapted from Leppänen et al. 2012 (SPREAD project).

DYNAMIX APPROACH: KEY TARGETS FOR 2050

- 2 t CO₂ eq pro capite
- 80% cut in virgin metals consumption
- Zero net demand for non-UE agricultural soil
- *Cut in the use of excess nutrients (P and N)*
- *Eradication of water scarcity*

Targets based on scientific literature and EU documents. Meant as a contribution to international debate

DYNAMIX: RESEARCH TOPICS

Qualitative and
quantitative
analysis of three
policy mixes



Compatibility with
Environmental targets
Environmental,
economic and social
impacts
Legal feasibility
Public acceptability

Agriculture
and Food

Metals

Overarching

QUANTITATIVE ANALYSIS

AIMS

Apply a set of different and complementary modelling tools to integrate Dynamix qualitative findings with quantitative evidence on the cost and effectiveness of the policy mixes discussed.

We look at the quantifiable elements of the policy mixes and leave non-quantifiable ones for the qualitative analysis

THE DYNAMIX MODELLING TOOLBOX

MODEL	Type	Geographic detail	Sectoral detail	Tech. Progress	Type of dynamics	Labour Market
ICES	Global CGE model	EU at the member state	20	Exogenous	Myopic (backward looking)	Fully competitive
MEMO	Dynamic stochastic CGE model	EU aggregated	10	Endogenous	Full (forward looking)	Imperfect
MEWA	Dynamic stochastic CGE model	EU aggregated	15	Endogenous	Full (forward looking)	Imperfect
ILCD	Material LCA	EU aggregated	13	--	--	--

THE POLICY AND MODELLING MATRIX (SELECTION)

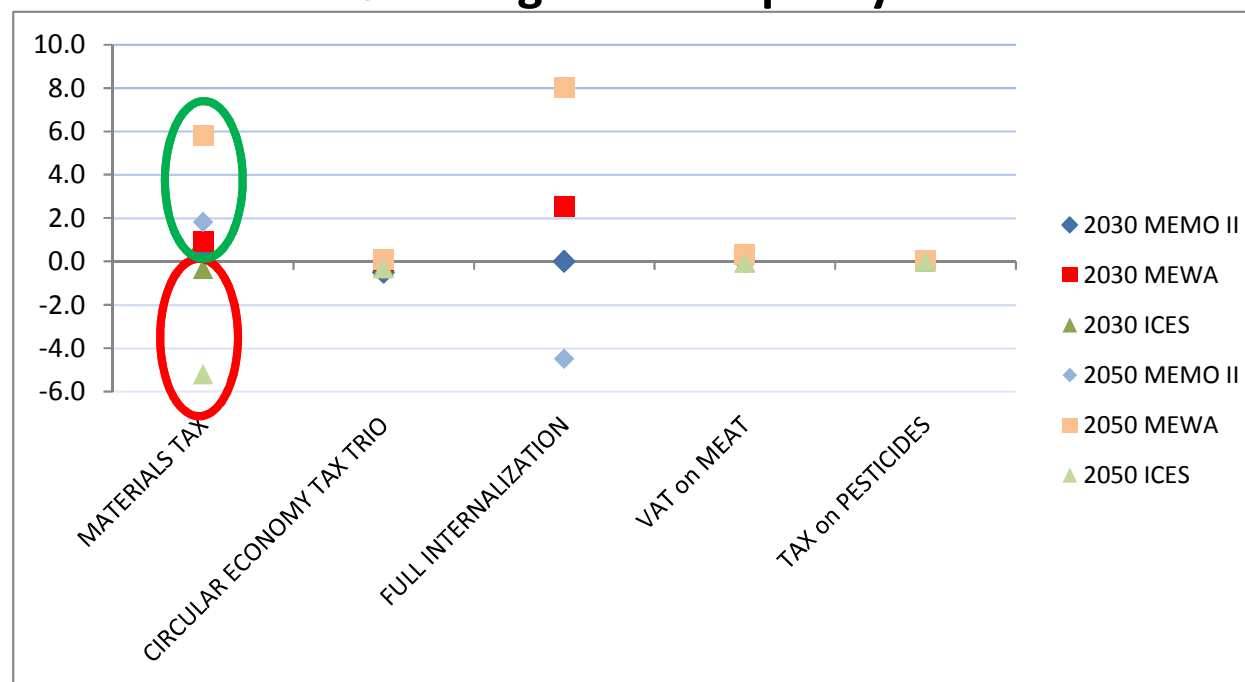
Policy mix	Policy measures	ICES	MEMO II	MEWA	ILCD
Metals and Other Materials (MOM)	Materials tax	x	x	x	x
	Internalisation of external environmental costs		x	x	
	Increased spending on research and development			x	
Land-Use (LU)	Strengthened pesticide reduction targets under the Pesticides Directive	x		x	x
	Targeted information campaign to influence food behaviour towards changing diets	x			x
	VAT on meat	x	x	x	x
Overarching (O)	“Circular economy tax trio”	x	x	x	
	Enabling shift from consumption to leisure			x	

IMPLEMENTING THE POLICIES

Policy fiche	What	How much	When
Materials tax	ICES: Sales tax of wood and mining to all other sectors (excluding fossil fuel extraction) + Sales tax of Oil Products to Chemicals. MEMO II and MEWA: Sales tax of wood, fuels, metal and other to all manufacturing sectors and construction + sales tax of chemical, metal and non-metallic mineral (excluding tax they pay for raw material purchase) to manufacturing and construction sector + MEMO II: 50% recycling to reduce labour taxation MEWA: a) 100% recycling to reduce labour taxation, firms cannot pursue material efficiency improvements; b) decrease in labour taxation, firms can pursue material efficiency improvements; c) decrease in labour taxation and support to R&D in material efficiency.	3 pp/year (up to 30%) 8.5 pp/year (up to 200%)	2021-2030 2031-2050
Internalisation of external environmental costs	Excise tax on all sectors, but services a) common flat tax rate to all sectors; b) sector specific rate based on actual externalities MEMO II 50% recycling to reduce labour taxation MEWA 100% recycling to reduce labour taxation	linear increase up to 35%	2030-2050
Strengthened pesticide reduction targets under the Pesticides Directive	Tax on domestic and imported sales of chemicals to the agriculture sector	8% linear increase up to 20%	2020-2050
VAT on meat	Fill the gap between current VAT on meat and the average country-specific/EU VAT	13 pp (EU average, in ICES country-specific)	2020 (kept constant up to 2050)
Circular economy tax trio	ICES and MEMO II: Tax on domestic sales of mining (excluding fossil fuels) to non-metallic minerals and construction + Tax on exports of non-metallic minerals. MEWA: Tax on virgin materials, landfills and waste incineration	38% linear increase up to 50%	2018-2050

THE GDP COST OF THE POLICIES

EU: % changes wrt no policy case



With cut in
labour taxes and
endogenous TP

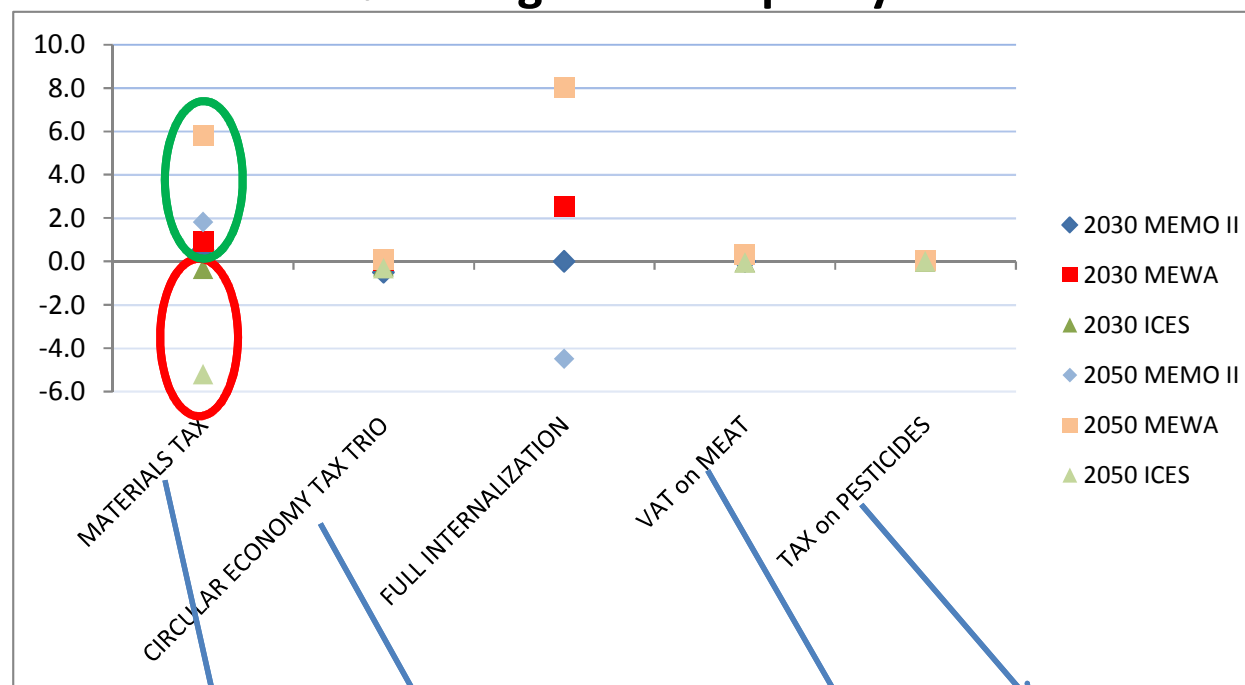
With lump-sum
rebates and
exogenous TP

«dematerialization
policies»

«Land-use policies»

THE GDP COST OF THE POLICIES

EU: % changes wrt no policy case



With cut in
labour taxes and
endogenous TP

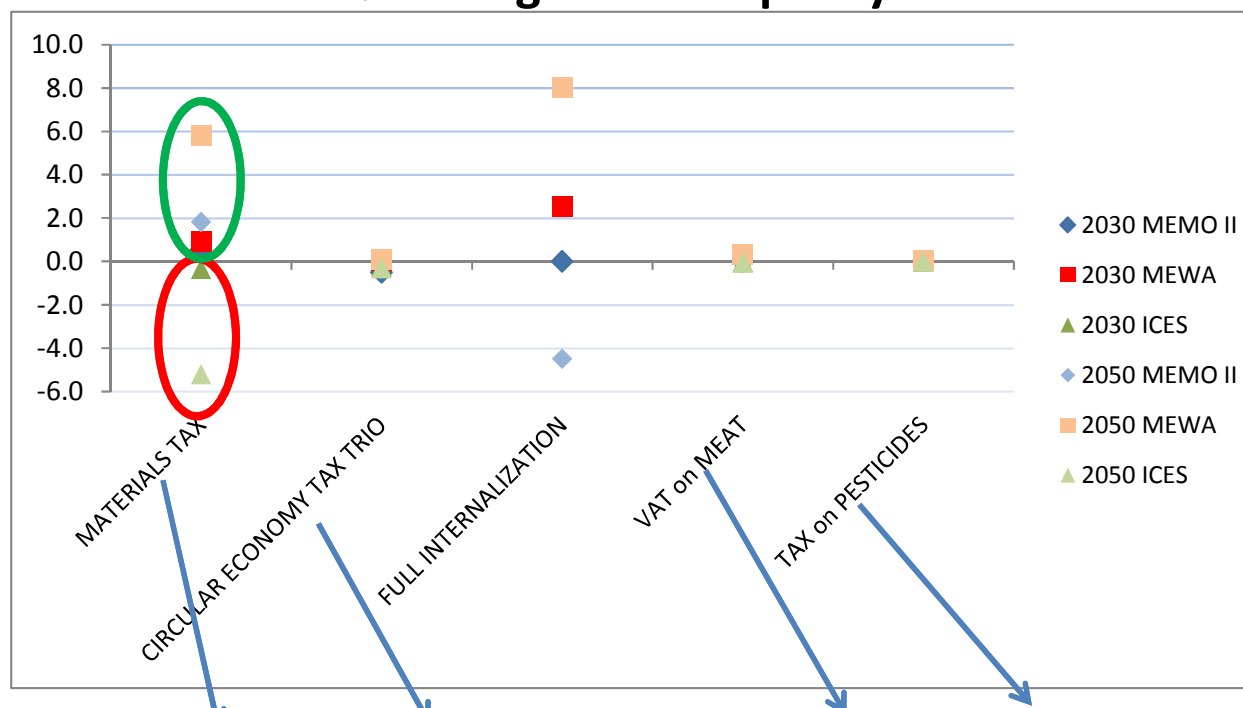
With lump-sum
rebates and
exogenous TP

Worst off country in
2050 (ICES)

-22%	-1.47%	--	-0.21%	-0.35%
Finland	Czech.Rep.		Poland	Austria

THE GDP COST OF THE POLICIES

EU: % changes wrt no policy case

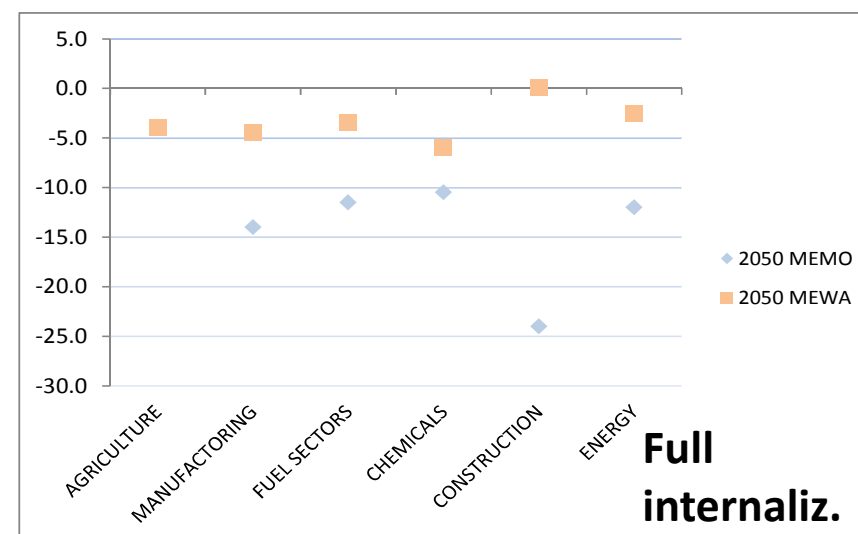
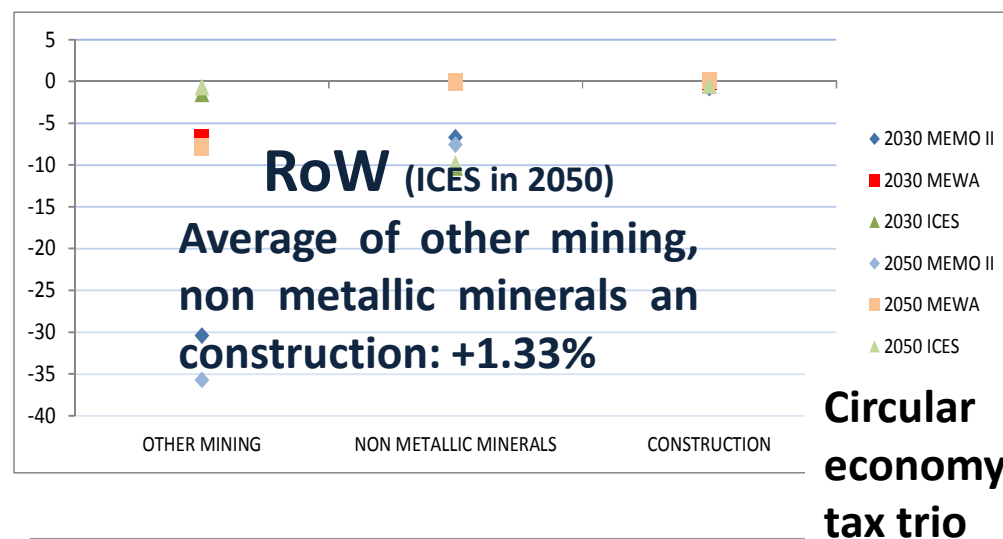
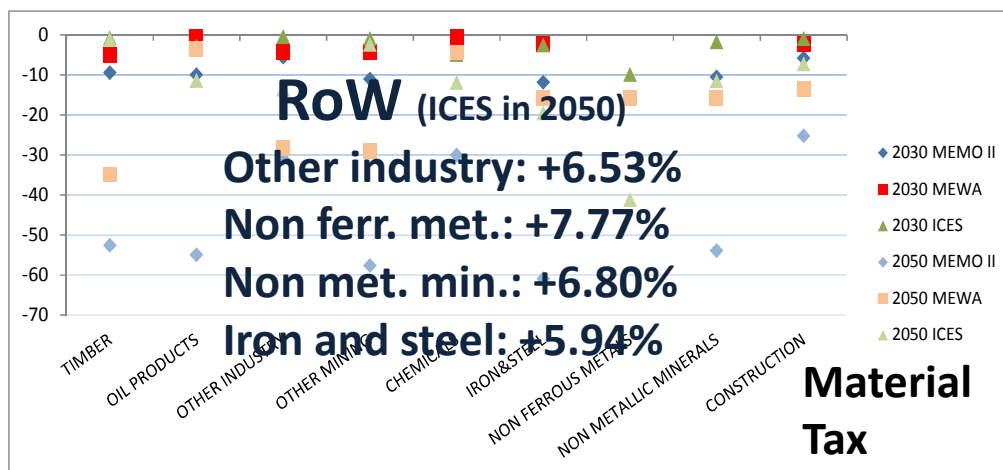


With cut in
labour taxes and
endogenous TP

With lump-sum
rebates and
exogenous TP

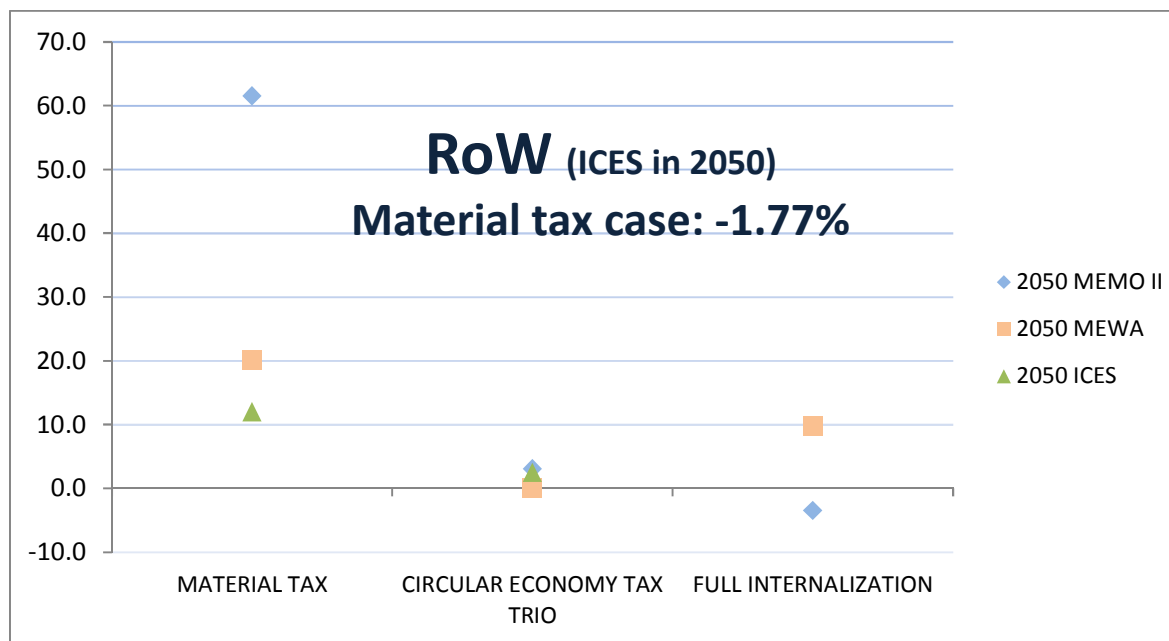
GDP RoW in 2050 (ICES) % change wrt no policy case	+ 0.72%	+ 0.04%	--	+ 0.01%	- 0.0024
GDP BRICS in 2050 (ICES) % change wrt no policy case	+ 0.76%	+ 0.04%	--	+ 0.01%	- 0.0041

DE-MAT. POLICY EFFECTIVENESS: PRODUCTION



EU: % changes wrt no policy case
 In ICES tax revenues are rebated lump-sum to households, in MEMO II they are 50% recycled through cut in labour taxes; in MEWA they are 100% recycled through cut in labour taxes.

DE-MAT. POLICY EFFECTIVENESS: MATERIAL “EFFICIENCY”



EU: % changes wrt no policy baseline.

Material efficiency expressed in MEMO II as (value of) output/material inputs; ICES and MEWA as improvement in the GDP/material input ratio.

In ICES tax revenues are rebated lump-sum to households, in MEMO II they are 50% recycled through cut in labour taxes; in MEWA they are 100% recycled through cut in labour taxes.

QUALITATIVE POLICY ASSESSMENT

FOUR relevant criteria of the economic policy analysis
(Rossell, 1993)

EFFECTIVENESS

EFFICIENCY

EQUITY

FEASIBILITY

Step 1:

screen the economic policy literature in the broadest sense
(priority to studies focusing on the EU and its member States)

Step 2:

study the implementation process and the effects of other policies
use these findings to shed light on the performance of the policy measures
under investigation

A HYPOTHETICAL POLICY MIX FOR DEMATERIALIZATION

ONE major policy objective:
containing the use of a set of virgin resources



reducing the externalities related to extraction & refinement activities
THREE policy measures, which all target manufacturing firms (Phase 2):

Market-based	G T R		a material tax
			an R&D subsidy scheme in the area of resource efficiency
Information & education	a set of skill enhancement programmes		
Command-and-control	a set of product standards		

MAJOR FINDINGS

EFFECTIVENESS

- The quantitative relationship between the EU and the world resource consumption is unknown, then...
dematerialization in the EU may not automatically imply a contraction in the extracted quantities at global level
- In the short run: low elasticity of resource demand to price changes
- In the long run: risks connected with outsourcing/offshoring

EFFICIENCY

- A material tax is resource-specific but...
the same natural resource can be extracted and refined using different technologies, with different environmental impacts.

THE GENERAL CONTEXT FOR ANY POLICY INITIATIVE ON DEMATERIALIZATION

- computed levels of RMC are very heterogeneous across studies
- extracted quantities in the EU (DE) are below 10%:

	Total		Biomass		Construction materials		Metal ores		Abiotic materials	
EU-28	4,581	8.06%	1,579	7.78%	2,803	9.47%	199	2.85%	3,002	8.21%

- raw material consumption (RMC) levels in the EU are

	Total		Biomass		Construction materials		Metal ores		Abiotic materials	
EU-28	8,905.8	15.66%	2,735.9	13.48%	4,974.5	16.81%	1,195.4	17.12%	6,169.9	16.87%

- unknown relationship between EU RMC and global RMC

CONCLUSIONS

Quantitative analysis shows that dematerialization faces some fundamental challenges:

- Implemented through material pricing (taxation) it can exert important depressing effect on growth. A proper use of revenues is thus crucial.
 - Substantive technological advancements are also needed to avoid booming in policy costs. Policies should be designed to stimulate technological progress
 - Effectiveness in the EU does not guarantee undesired effects outside the EU (economic «leakages» and increased materialization). International coordination needed.
 - Some policies (e.g. on pesticides, on virgin materials, meat) address relatively «narrow» sectors in economic terms, have thus mainly a sectoral relevance, but not «systemic» effects.
-

CONCLUSIONS

- Qualitative policy assessment complements quantitative approaches, as it allows tackling a number of (unquantifiable) aspects, which would otherwise be neglected.
 - Setting dematerialization as the main objective may be economically inefficient.
 - By targeting material throughputs instead of externalities, the risk is to miss the opportunities offered by direct interventions where externalities arise.
 - Within the same material type, it is necessary to distinguish between units extracted through environmentally friendly or unfriendly processes.
 - Moreover, there is a risk that dematerialization focused on a given resource type gives rise to a more intensive use of another resource type.
 - Policy focus should move away from used materials to processes as these differ from one another, and they are responsible for different environmental impacts.
 - By raising materials prices, this strategy can ultimately lead to (hopefully efficient) dematerialization.
-

OVERALL...



Dynamix synthesis report concludes that:

- Development of consistent and coherent policy mixes can contribute to a more effective strategy for policy-making.
- The concept of policy mixes appears to clash with current political realities and practical experience.
- The Dynamix heuristic framework worked in designing, discussing and justifying the policy mixes and benefited from interaction with stakeholders
- Preventing burden-shifting called for a broad perspective in designing policy mixes, which had to include primary and ancillary instruments in a non-obvious way.
- This contributed to fairly positive results from the environmental and economic models used for ex-ante assessment of the policy mixes.
- However, the quantitative assessment results indicate that the policy mixes will not be sufficient to reach the predefined environmental targets of DYNAMIX.

GRAZIE!

THE DYNAMIX FEEM TEAM

MARIAESTER CASSINELLI
FRANCESCA PONGIGLIONE
FRANCESCO BOSELLO
FABIO EBOLI
JACOPO ZOTTI
ANDREA BIGANO

andrea.bigano@feem.it



This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 308674. It lasted from September 2012 to March 2016.