

# Seminario «*I conti ambientali per l'economia circolare. Strumenti e modelli per le politiche*»

## *I conti dei flussi di materia*

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# CREIAMO PA

Per un cambiamento sostenibile

# EW-MFA: Economy Wide - Material Flow Accounts

IE-CFM – Conti Fisici della Materia al livello di Intera Economia

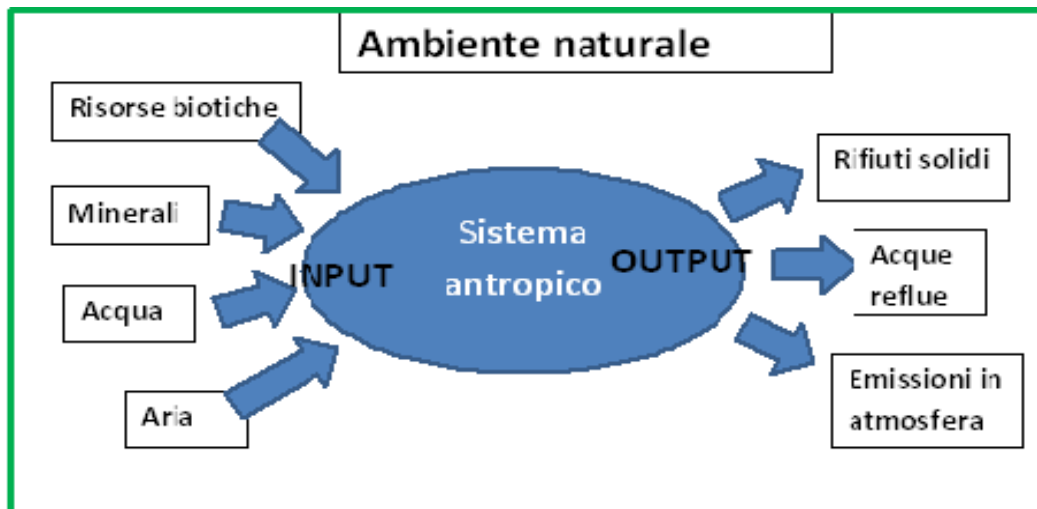
- Paradigma di riferimento
- EW-MFA. Concetti e definizioni
- Le fonti metodologiche
- oltre l'EW: «NAMEA», Supply/Use, Input/Output



# Concetti e definizioni: Paradigma del metabolismo socioeconomico

Il **sistema socio-economico (o antropico)** è un sottosistema di un sistema più vasto – la biosfera (o *Ambiente naturale*) e - similmente agli esseri viventi - dipendente da un flusso costante di materiali e energia da e verso questo sistema.

riceve in **input** materia e energia, li trasforma,  
quindi restituisce un **output** di materia ed energia **degradata**



Idea di base:

La magnitudine e la qualità di questi flussi danno una descrizione e una misura globale (forse la più completa) della pressione antropica sugli ecosistemi.

Fischer-Kowalski Istituto di Ecologia Sociale di Vienna

L'ecologia sociale "si concentra sulle interazioni tra sistemi sociali e naturali vedendoli come strutturalmente accoppiati, indagando i cambiamenti introdotti dalla loro coevoluzione"



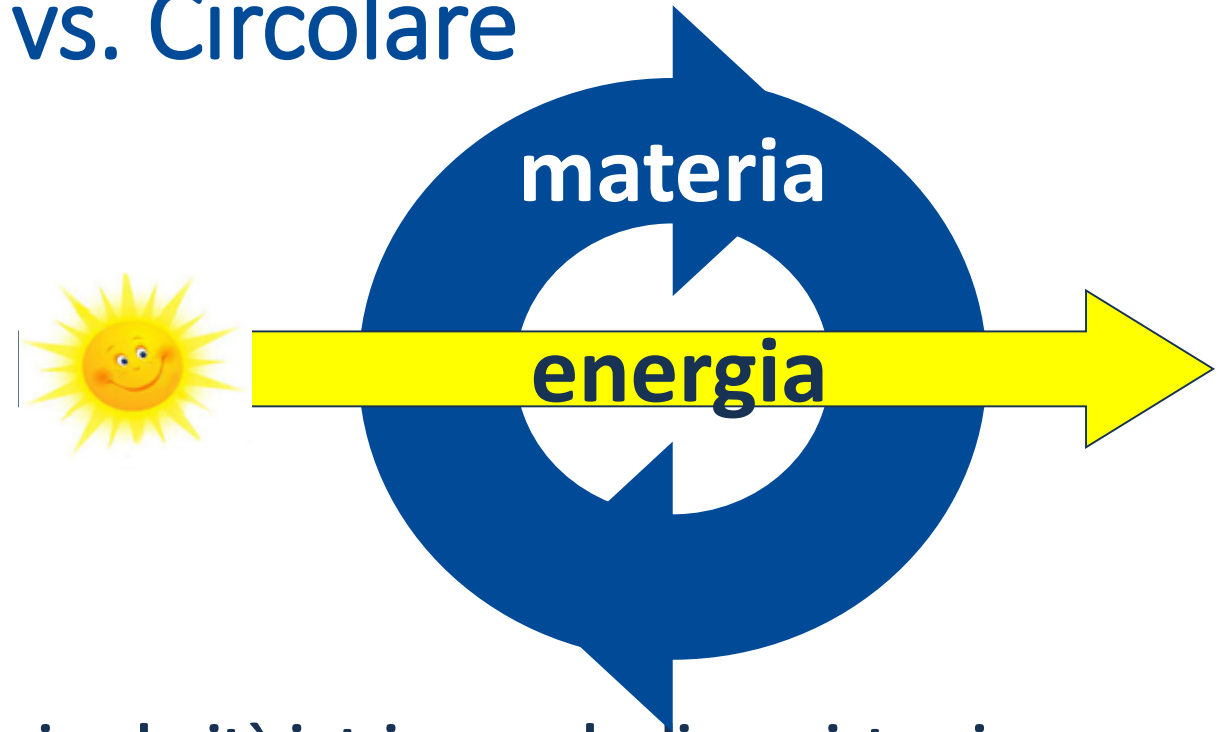
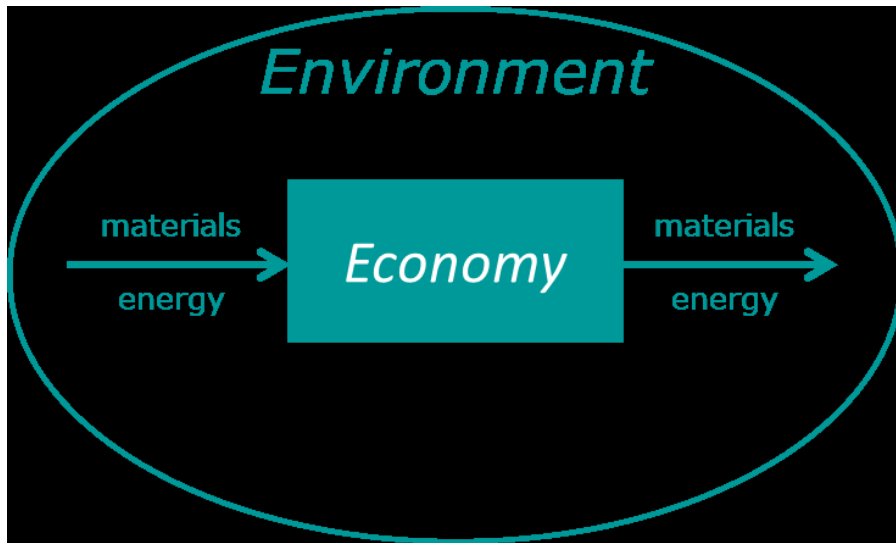
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# *Interazione tra sistemi*

- La biosfera (ambiente naturale) è un unico sistema bio-fisico.
- Lo possiamo suddividere in due grandi sottosistemi:
  - Sistema socio-economico (o antropico)
  - Sistema o ambiente naturale
- Le interazioni sono flussi/scambi di energia, materia e informazione.
- Convenzionalmente li consideriamo dal lato del sistema antropico:
  - Input sono i flussi verso il sistema antropico
  - Output sono i flussi dal sistema antropico
- La separazione che operiamo è:
  - netta: non vi sono elementi appartenenti ad entrambe i sistemi contemporaneamente.
  - In molti casi fortemente arbitraria (o convenzionale).



# Lineare vs. Circolare



**L'economia circolare** vuole ispirarsi alla **circularità intrinseca degli ecosistemi**, con scambi di materia minimizzati, e più ancora **della biosfera**, dove il ciclo della **materia** è sostenuto da un flusso costante di **energia**.

Ma questa energia ha una fonte materiale esterna (il sole), non è prodotta da trasformazioni della materia terrestre (i fossili) che generano residui non recuperabili.



# Circolarità della materia negli ecosistemi

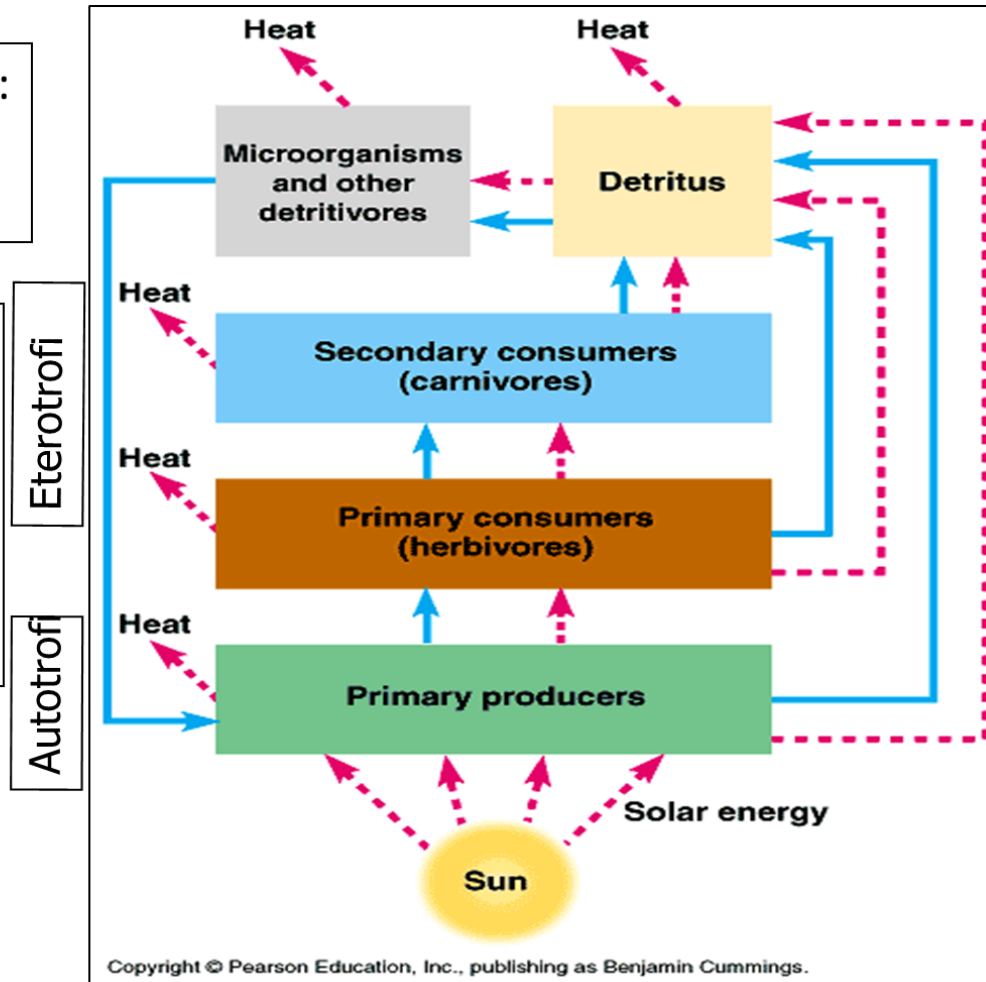
Dinamica degli ecosistemi:

1- Flussi di energia

2- Cicli biogeochimici

**ENERGIA** – Non può essere riciclata, fluisce attraverso gli ecosistemi, proviene da una fonte esterna. Entra come luce ed esce come calore.

**MATERIA** – Circola all'interno degli ecosistemi.



# EW-MFA: A...

- A = Accounts (nel contesto della statistica ufficiale)  
...ma in altri contesti, di ricerca, A = Analysis.
- Nel quadro dei conti economici regolati dal Sistema Europeo dei Conti (SEC) è considerato un **Conto satellite**.
- Regolamentato operativamente da uno dei 6 moduli del Reg. CE/691/2011
  
- **Cosa contiamo? La MATERIA!**
- **Quale sua proprietà fisica? Il PESO!**
- **Quale unità di misura? La tonnellata (Mg) e i suoi multipli (Gg, Tg)**
- Nei dati statistici di base sono però presenti misurazioni di altre grandezze, per esempio il volume, o il numero di «pezzi» o «unità».
- In questi casi è necessario disporre di appropriati metodi di conversione.



# Circolazione di materia vs. circolazione monetaria

Descrizione della circolazione dei valori economici

## **Sistema chiuso**

La **moneta** come unità di misura è applicabile solo all'interno del sistema antropico.

Descrizione della circolazione di **materia ed energia**

## **Sistema aperto**

Fuori dal sistema antropico si verificano fenomeni misurabili esclusivamente in termini fisici: peso, volume, superficie, energia, numero di individui o di oggetti, ecc.





## Economy-wide material flow accounts

HANDBOOK

2018 edition



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# System of Environmental-Economic Accounting 2012 Central Framework



EW-MFA are consistent with and conceptually embedded into the wider framework of the System of Environmental-Economic Accounting 2012 – Central Framework (United Nations et. al. 2014). ([https://unstats.un.org/unsd/envaccounting/seearev/seea\\_cf\\_final\\_en.pdf](https://unstats.un.org/unsd/envaccounting/seearev/seea_cf_final_en.pdf))

The SEEA-CF 2012 lays down the internationally agreed standard concepts, definitions, classifications, accounting rules and tables for producing internationally comparable statistics on the environment and its relationship with the economy.

The SEEA-CF 2012 is aligned and builds on the concepts, definitions and classifications of national accounts – the international System of National Accounts (SNA 2008, see: United Nations et al. 2009) and its European version European system of accounts (ESA 2010; see: Eurostat 2013b),



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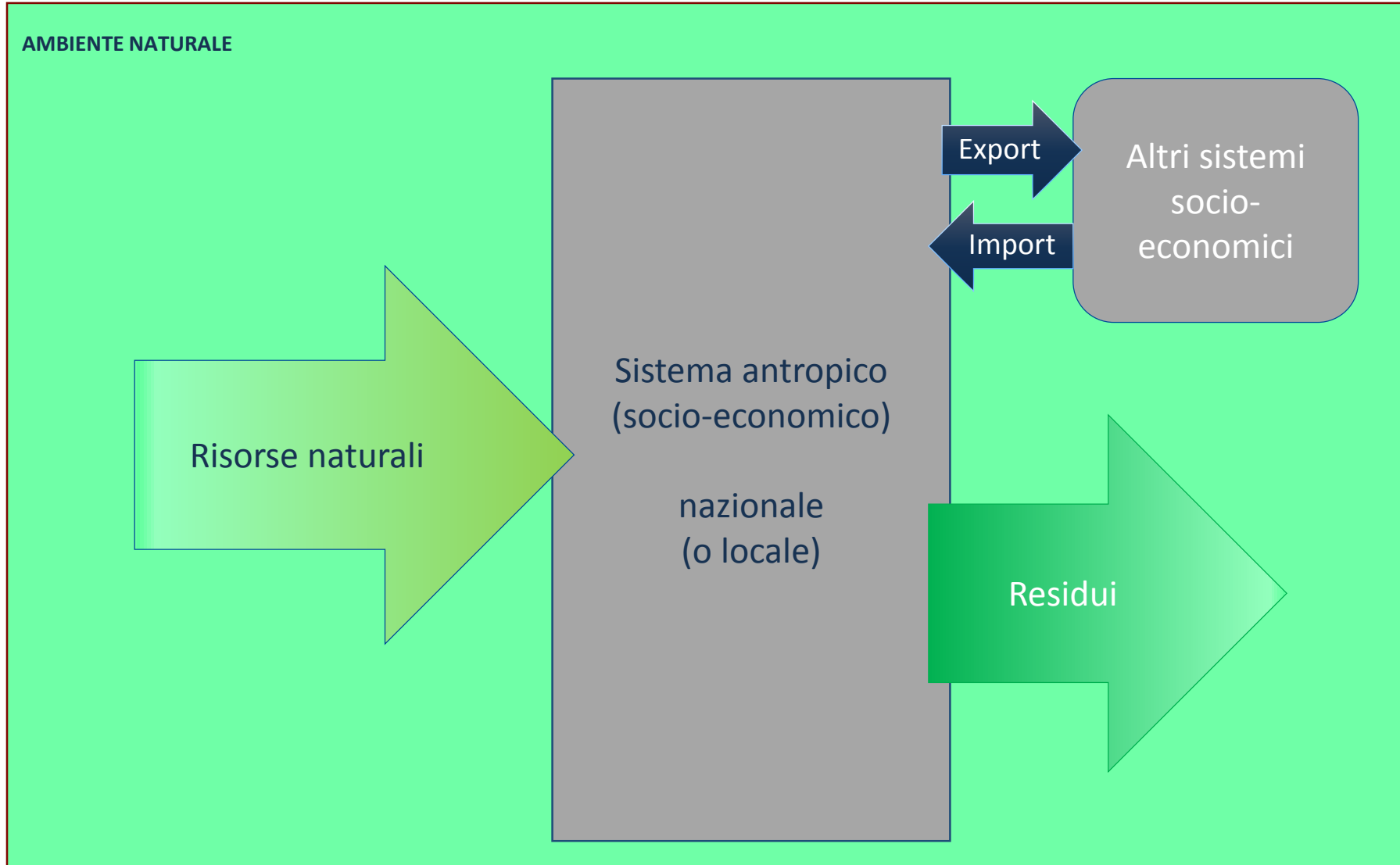


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# EW-MFA: Flows. Quali?



# Flussi tra ambiente e ed economia.

## Material flows from the environment to the economy = domestic extraction

32. Material inputs derived from the environment and used within the economy refer to the extraction or movement of natural materials on purpose and by humans or human-controlled means of technology. These flows accounted for in EWMFA have been termed **domestic extraction**. The extraction of materials causes various pressures on the natural environment, such as e.g. disruption of natural material and energy cycles and other ecosystem services.

## Material flows from the economy to the environment = domestic processed output

33. Once entered into the economy materials are transformed and used in manifold ways. Some materials stay longer in the economy, others shorter. Materials are released back to the natural environment in the form of residual material (e.g. emissions to air and water). These outputs accounted for in EW-MFA have been termed **domestic processed output**. They refer to material flows entering the environment as a result of production or consumption processes. Material outputs released to the environment means that society loses control over the location and composition of materials (Eurostat 2001, para. 3.10).



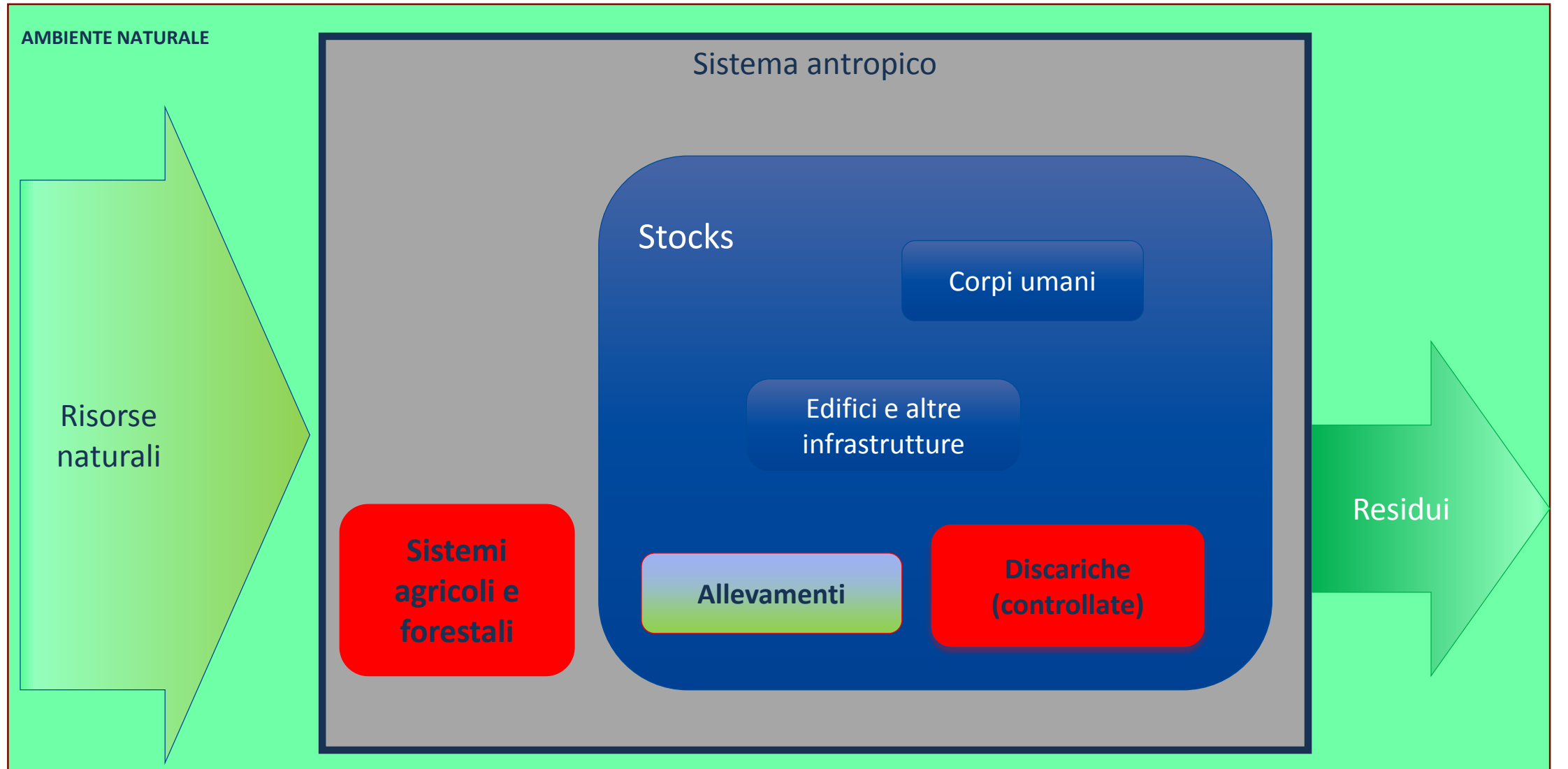


# EW-MFA: *Flows, non stocks!*

- The SEEA-CF 2012 distinguishes physical flow accounts from physical asset accounts (SEEA-CF 2012, paras. 2.87ff, para. 3.3). EW-MFA are categorised as physical flow accounts.
- Non misura le riserve di risorse naturali (assets), o di beni accumulati (stocks).
- Uno stock/asset si misura in un dato istante di tempo Normalmente ogni anno (i.g. 31-12-2017, 31-12-2018, ecc.).
- Un flusso si misura per un dato periodo di tempo. Normalmente di un anno (i.g. 2017, 2018, ecc).



# I confini del sistema





# EW-MFA. Flows. I Confini del sistema

28. It is relevant to note that according to national accounts and SEEA-CF **controlled landfills** and the stocks of **cultivated agricultural plants** and **forests** belong to the stock of produced assets of the economy; i.e. are considered **within the boundary** of the economy

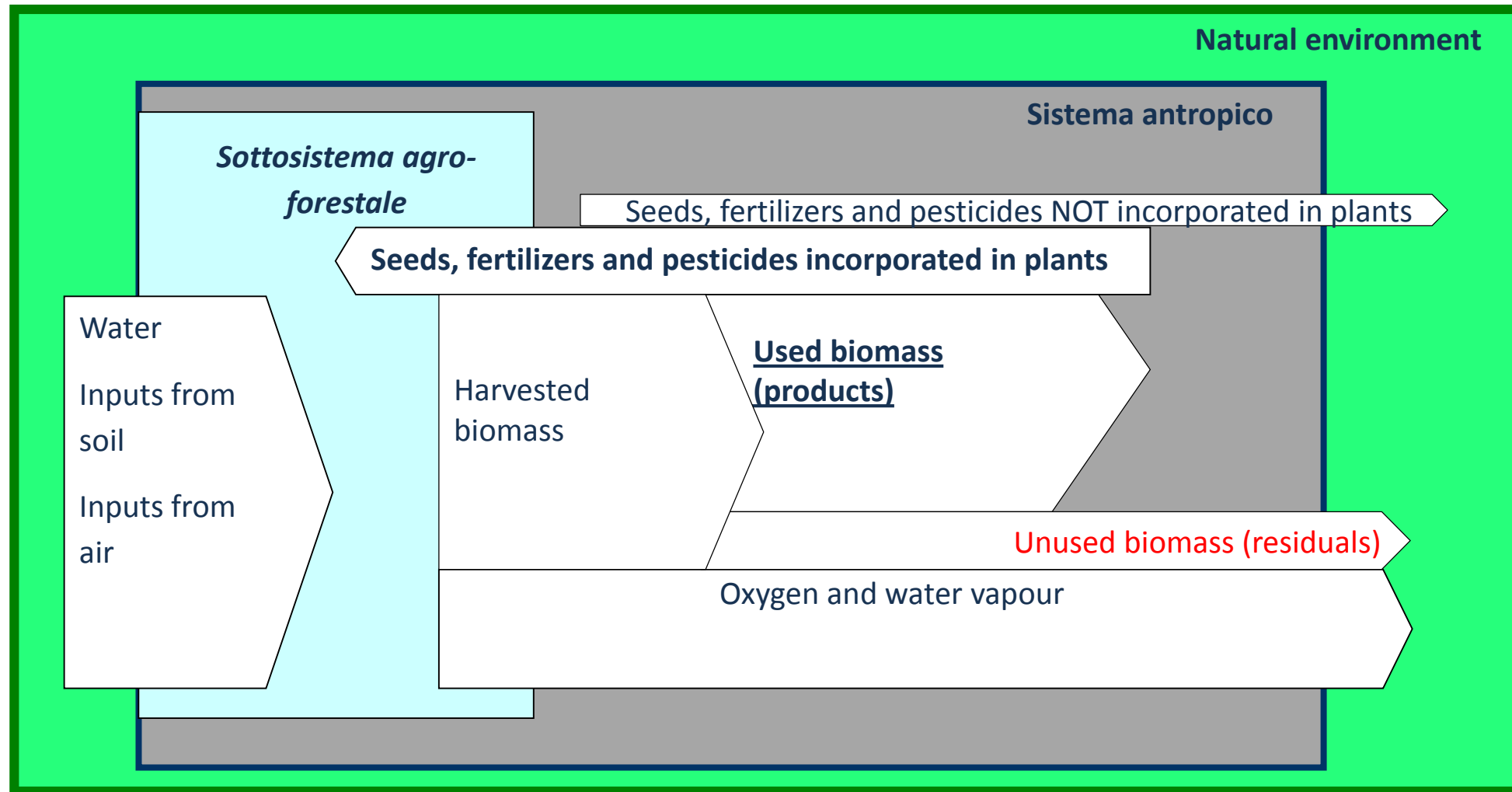
34.... It was concluded that in certain cases deviating from national accounts' definition of the boundary of the economy could be more meaningful and more practical in the context of EW-MFA.

35 ...Two particular cases were identified for which conventions had to be settled potentially: (1) treatment of domestic extractions in relation to production of **cultivated biological resources** (agricultural plants and forests), and (2) treatment of domestic processed output in relation to **controlled landfills**.

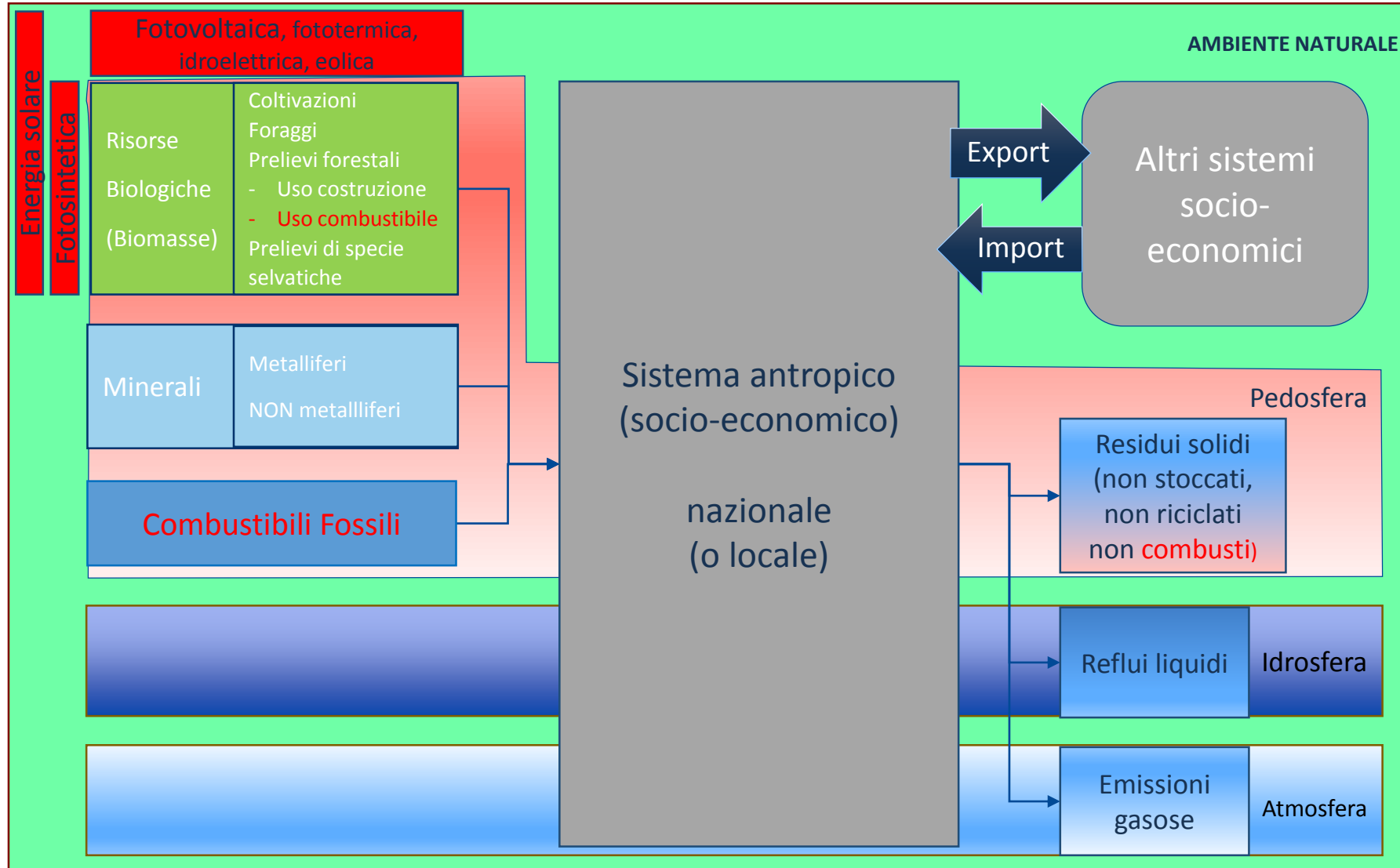
36 ...Here, the specific EW-MFA recording convention was introduced to account for the harvested amounts of biomass instead of accounting for the flows of nutrients, carbon dioxide etc. **This convention has been termed 'harvest-approach'**.



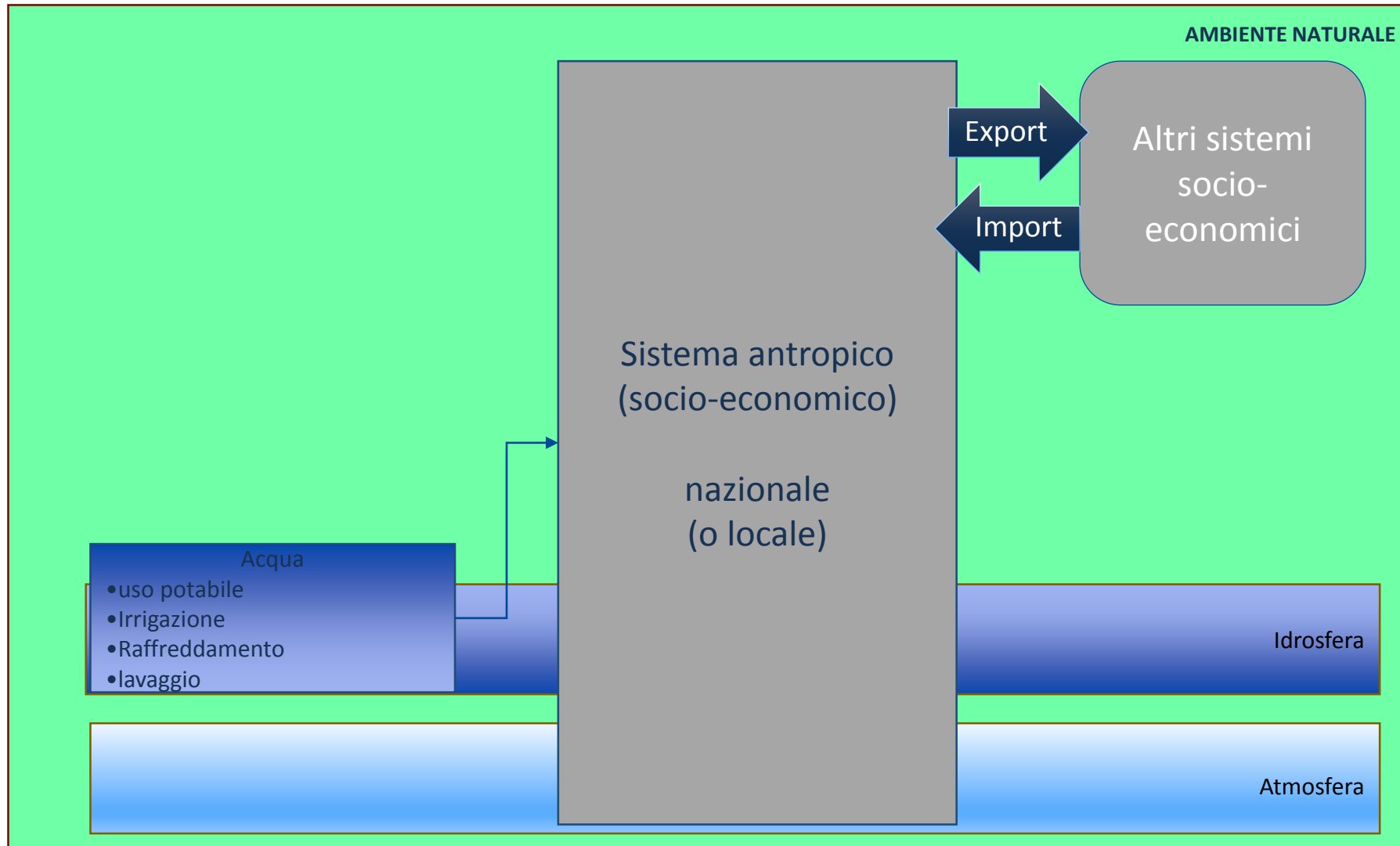
# EW-MFA. I confini del sistema: i sistemi agroforestali



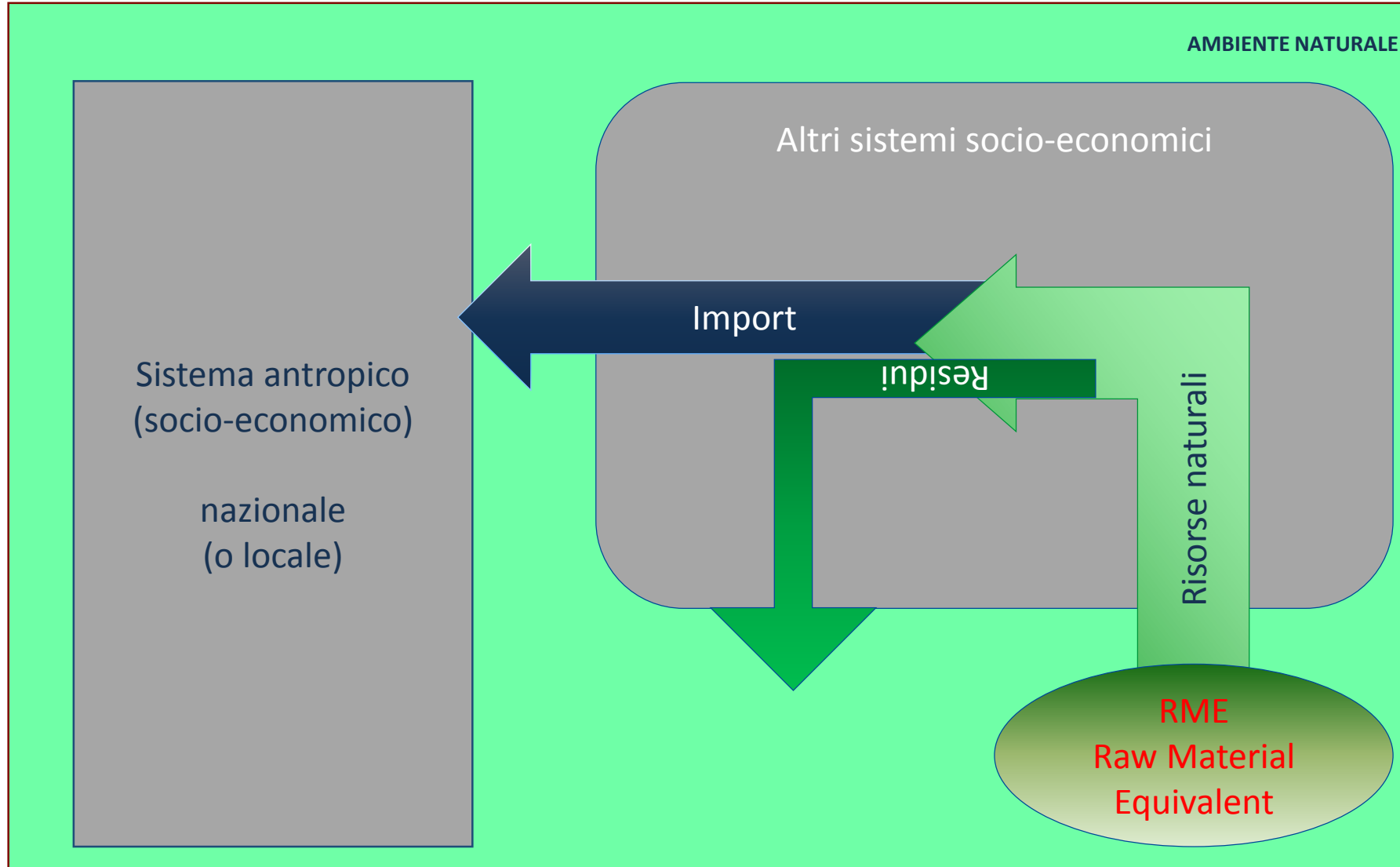
# EW-MFA: Material



# EW-MFA – Materiali esclusi



# EW-MFA – Flussi esclusi: indiretti



# EW-MFA – Flussi esclusi: indiretti

## Flussi diretti

- materia direttamente importata o esportata (materie prime o “prodotti compositi”).

## Flussi indiretti

Tutto ciò che è necessario all'estero per produrre quanto è direttamente importato (a meno di quanto incorporato nel flusso diretto).

- materia utilizzata (Raw Material Equivalents)
- materia non utilizzata (NON COMPRESA IN RME!!!!)

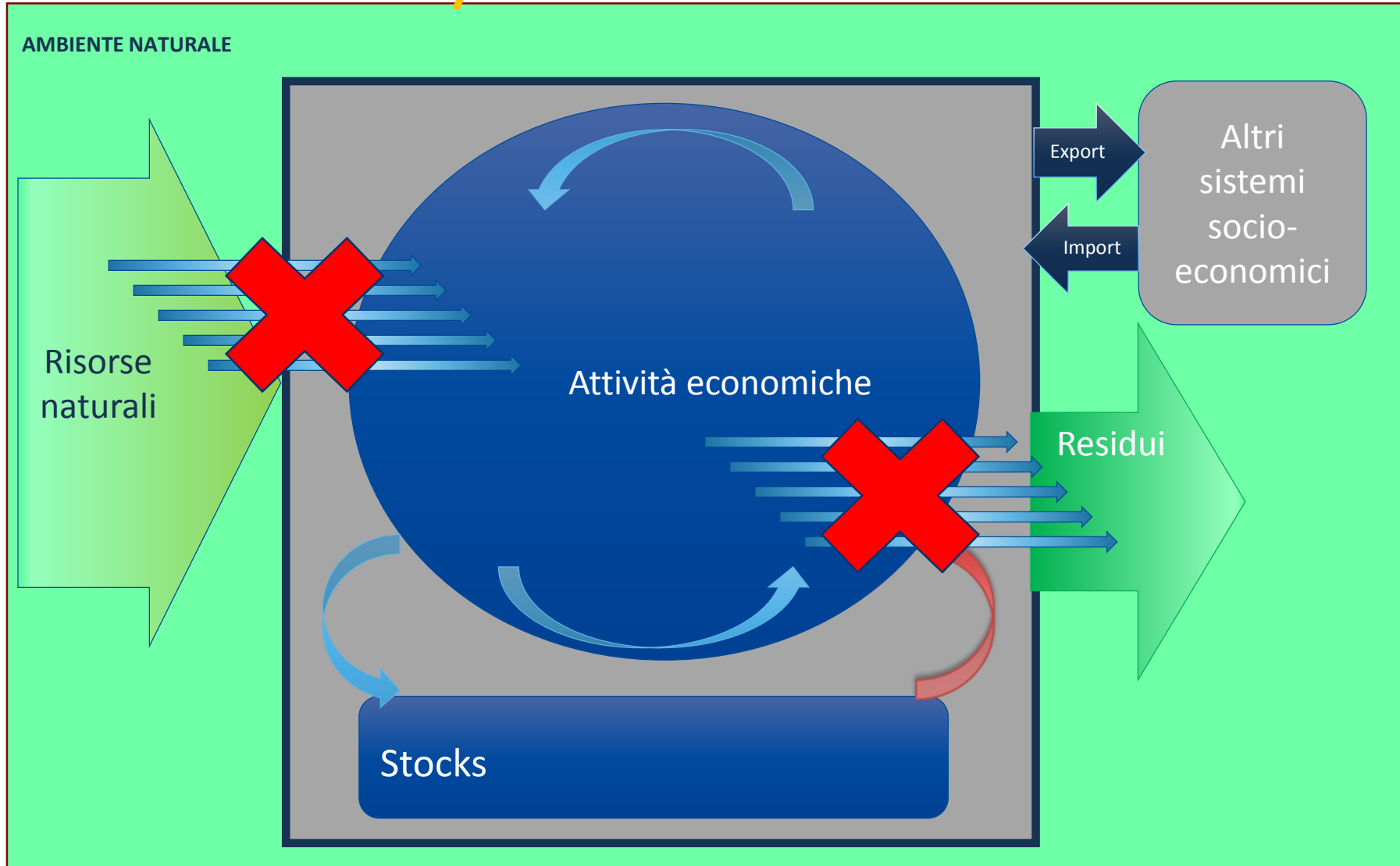


# EW-MFA – Flussi esclusi: Materiali inutilizzati (Unused)

- I materiali utilizzati (*used*) sono quelli che vengono incorporati nei prodotti ad un qualche stadio del processo economico (granaglie, petrolio, minerale di ferro, argilla...
- I materiali inutilizzati (*unused*) sono rifiuti già al momento della loro prima movimentazione (cascami agricoli, residui di trivellazione, scarti di estrazione...



# EW-MFA: Economy Wide. Flussi «tra» sistemi





# Flussi in output: Rifiuti solidi

- 409. DPO item MF.7.2 includes only those amounts of solid waste which are disposed to the natural environment; i.e. to uncontrolled landfills. In Europe, one may assume that this is zero because uncontrolled landfills are illegal.
- 410. Notably, in EW-MFA any solid waste disposed to controlled landfills is considered a flow within the economy (and not to the environment). According to principles, concepts, and definitions in national accounts and SEEA controlled and managed landfill sites are considered to be part of the produced assets of the national economy. This implies that waste disposed to controlled landfills is **part of the net additions to stock (NAS).**
- 411. EW-MF experts have agreed to record solid waste flow to controlled and managed landfills as memo item in Table F of the EW-MFA questionnaire. It is a useful piece of information when analysing the net additions to stock (NAS). Waste disposed to controlled landfills may form a quantitative relevant part of NAS.



# Domestic Extraction (DE) (44 items) (dati 2015)

<b>MF.1 Biomass</b>	<b>101.110</b>	<b>MF.3 Non-metallic minerals</b>	<b>239.597</b>
MF.1.1 Crops (excluding fodder crops)	57.783	MF.3.1 Marble, granite, sandstone, porphyry, basalt, other ornamental or building stone	21.167
MF.1.1.1 Cereals	17.122	MF.3.2 Chalk and dolomite	879
MF.1.1.2 Roots, tubers	1.486	MF.3.3 Slate	28
MF.1.1.3 Sugar crops	2.184	MF.3.4 Chemical and fertilizer minerals	217
MF.1.1.4 Pulses	137	MF.3.5 Salt	2.728
MF.1.1.5 Nuts	192	MF.3.6 Limestone and gypsum	28.722
MF.1.1.6 Oil-bearing crops	4.481	MF.3.7 Clays and kaolin	4.378
MF.1.1.7 Vegetables	13.523	MF.3.8 Sand and gravel	176.253
MF.1.1.8 Fruits	17.820	MF.3.9 Other non-metallic minerals n.e.c	5.225
MF.1.1.9 Fibres	4	MF.3.A Excavated earthen materials (including soil), only if used	0
MF.1.1.A Other crops (excluding fodder crops) n.e.c.	834	<b>MF.4 Fossil energy materials/carriers</b>	<b>10.301</b>
MF.1.2 Crop residues (used), fodder crops and grazed biomass	38.531	MF.4.1 Coal and other solid energy materials/carriers	57
MF.1.2.1 Crop residues (used)	5.992	MF.4.1.1 Lignite (brown coal)	0
MF.1.2.1.1 Straw	4.914	MF.4.1.2 Hard coal	57
MF.1.2.1.2 Other crop residues (sugar and fodder beet leaves, etc.)	1.078	MF.4.1.3 Oil shale and tar sands	0
MF.1.2.2 Fodder crops and grazed biomass	32.539	MF.4.1.4 Peat	0
MF.1.2.2.1 Fodder crops (including biomass harvest from grassland)	28.722	MF.4.2 Liquid and gaseous energy materials/carriers	10.244
MF.1.2.2.2 Grazed biomass	3.818	MF.4.2.1 Crude oil, condensate and natural gas liquids (NGL)	5.470
<b>MF.1.3 Wood</b>	<b>4.506</b>	MF.4.2.2 Natural gas	4.774
MF.1.3.1 Timber (Industrial roundwood)	1.798		
MF.1.3.2 Wood fuel and other extraction	2.709		
M.1.3 MEMO Net increment of timber stock (memo item - Growth - Harvest)	:		
MF.1.4 Wild fish catch, aquatic plants and animals, hunting and gathering	289		
MF.1.4.1 Wild fish catch	130		
MF.1.4.2 All other aquatic animals and plants	59		
MF.1.4.3 Hunting and gathering	101		
<b>MF.2 Metal ores (gross ores)</b>	<b>1.164</b>	<b>Total domestic extraction</b>	<b>352.172</b>
MF.2.1 Iron	0		
MF.2.2 Non-ferrous metal	1.164		
MF.2.2.1 Copper	0		
MF.2.2.2 Nickel	0		
MF.2.2.3 Lead	34		
MF.2.2.4 Zinc	0		
MF.2.2.5 Tin	0		
MF.2.2.6 Gold, silver, platinum and other precious metals	0		
MF.2.2.7 Bauxite and other aluminium	0		
MF.2.2.8 Uranium and thorium	0		
MF.2.2.9 Other non-ferrous metals	1.130		



# Domestic Processed Output (DPO) (30 items) (dati 2015)

F.1 Emissions to air	414.116	F.1.1 Carbon dioxide (CO2)	407.948	F.1.1.1 Carbon dioxide (CO2) from biomass combustion F.1.1.2 Carbon dioxide (CO2) excluding biomass combustion
		F.1.2 Methane (CH4)	1.538	
		F.1.3 Dinitrogen oxide (N2O)	22	
		F.1.4 Nitrous oxides (NOx)	928	
		F.1.5 Hydroflourcarbons (HFCs)	0	
		F.1.6 Perflourocarbons (PFCs)	0	
		F.1.7 Sulfur hexaflouride	0	
		F.1.8 Carbon monoxide (CO)	2.365	
		F.1.9 Non-methane volatile organic compounds (NMVOC)	807	
		F.1.10 Sulfur dioxide (SO2)	314	
		F.1.11 Ammonia (NH3)	15	
		F.1.12 Heavy metals	0	
		F.1.13 Persistent organic pollutants (POPs)	0	
		F.1.14 Particles (e.g. PM10, Dust)	179	
		F.1.15 Other (e.g. Nitrogen trifluoride - NF3)	0	
F.2 Waste disposal		F.2.1 Disposal of municipal waste to the environment		M.2.1 Disposal of municipal waste to controlled landfills
		F.2.2 Disposal of industrial waste to the environment		M.2.2 Disposal of industrial waste to controlled landfills
F.3 Emissions to water		F.3.1 Nitrogen (N)		
		F.3.2 Phosphorus (P)		
		F.3.3 Heavy metals		
		F.3.4 Other substances and (organic) materials		
		F.3.5 Dumping of materials at sea		
Dissipative use of products		F.4.1 Organic fertiliser (manure)		
		F.4.2 Mineral fertiliser		
		F.4.3 Sewage sludge		
		F.4.4 Compost		
		F.4.5 Pesticides		
		F.4.6 Seeds		
		F.4.7 Salt and other thawing materials spread on roads (incl. grit)		
		F.4.8 Solvents, laughing gas and other		



# Principali indicatori sintetici

- DMC: Domestic Material Consumption = Input di risorse naturali + Importazioni – Esportazioni

Presente tra gli indicatori BES

Non ancora elaborati dall'Istat:

- RMC: Raw Material Consumption = Input di risorse naturali + Importazioni espresse in RME – Esportazioni espresse in RME. Comprende i Flussi indiretti
- DPO: Domestic Processed Output = materia restituita all'ambiente naturale (Emissioni, fertilizzanti, pesticidi, altri usi e perdite dissipative)
- NAS: Net addition to stock = DMC – DPO + Balance Item (input) – Balance Items (output))



# Oltre la «Economy Wide»



I sottosistemi sono identificabili in piena analogia con quanto effettuato dalla scienza economica: **settori produttivi e utilizzi finali (consumi, accumulazione, esportazioni)**

Il sistema è composto di sottosistemi.

I sottosistemi trasformano la materia. I flussi interni sono flussi tra sottosistemi.

Intercettiamo la materia nei diversi stadi della sua **trasformazione**, in entrata e in uscita da ogni sottosistema



# Specificazione dei flussi al margine

- NAMEA sta per National Accounts Matrix including Environmental Accounts, ovvero “matrice di conti economici nazionali integrata con conti ambientali”
- Utilizzata per l’Air Emission Accounts (AEA): si specificano le emissioni (di 14 inquinanti) per ognuna delle attività di produzione (65) o di consumo (3)



# Le Matrici Supply/Use

	Sistema socioeconomico		Ambiente naturale
	Attività produttive (n colonne)	Resto del mondo (Importazioni)	
<b>Risorse (Supply)</b>			
Risorse naturali (r righe)			X
Prodotti (p righe)	X	X	
Residui (q righe)	X	X	

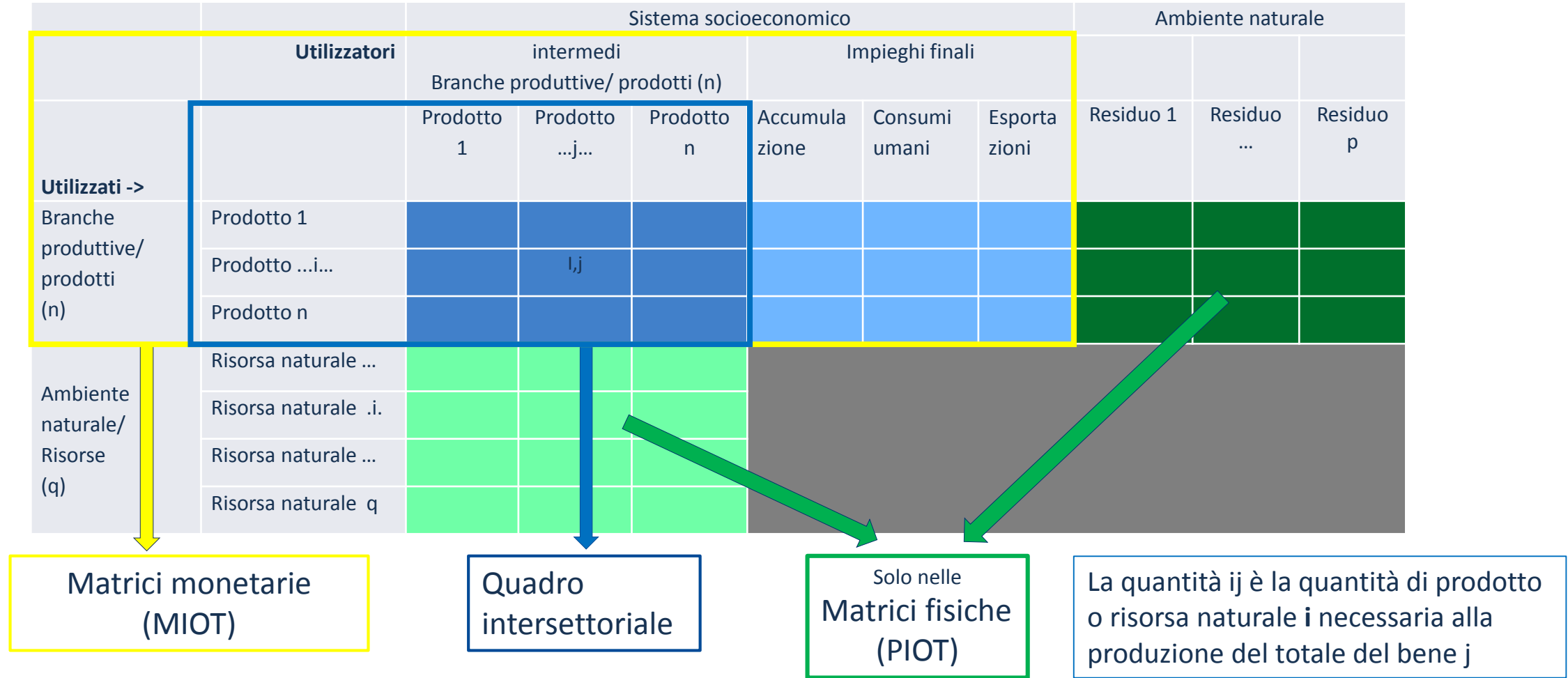
p(righe)=109;  
n= 68 (colonne) attività

Impieghi (Use)	Sistema socioeconomico				Ambiente naturale
	Attività produttive (n colonne)	Impieghi finali			
		Accumulazione	Consumi umani	Resto del mondo (Esportazioni)	
Risorse naturali (r righe)	X				
Prodotti (p righe)	X	X	X	X	
Residui (q righe)	X (riciclo o trattamento)	X (Discariche controllate)		X	X

In grigio la matrice in unità monetarie



# Le matrici input/output





# EW-MFA nel datawarehouse Istat

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Territorio	Italia				
Periodicità	annuale				
Edizione	Mar-2018				
Selezione periodo	2012	2013	2014	2015 i	2016
<b>Tipo aggregato (migliaia di tonnellate)</b>					
<b>IMD - Input Materiale Diretto i</b>	715 160	644 019	613 546	657 646 (p)	671 474
estrazione interna di materiali utilizzati	401 078	346 379	324 672	352 174 (p)	358 256
biomasse	109 978	107 848	112 899	101 112 (p)	111 467
minerali non energetici i	279 556	227 503	200 882	240 761 (p)	238 745
combustibili fossili	11 544	11 028	10 891	10 301 (p)	8 044
input diretti di materiali dall'estero	314 082	297 640	288 874	305 472 (p)	313 218
importazioni	309 534	293 142	284 316	300 506	308 177
impieghi all'estero dei residenti	4 548	4 498	4 558	4 966 (p)	5 041
<b>CMI - Consumo Materiale Interno (IMD - output verso l'estero) i</b>	564 729	497 680	474 852	505 489 (p)	515 358
<b>IMD - Input Materiale Diretto i</b>	715 160	644 019	613 546	657 646 (p)	671 474
estrazione interna di materiali utilizzati	401 078	346 379	324 672	352 174 (p)	358 256
biomasse	109 978	107 848	112 899	101 112 (p)	111 467
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importazioni	309 534	293 142	284 316	300 506	308 177
impieghi all'estero dei residenti	4 548	4 498	4 558	4 966 (p)	5 041
output diretti di materiali verso l'estero	150 431	146 339	138 694	152 157 (p)	156 116
esportazioni	146 027	142 169	134 592	147 570	151 822
impieghi in Italia dei non residenti	4 404	4 170	4 102	4 587 (p)	4 294
<b>BCF - Bilancia Commerciale Fisica</b>	163 651	151 301	150 180	153 315 (p)	157 102

Legenda:  
 p dato provvisorio  
 Dati estratti il 26 apr 2018, 16h33 UTC (GMT), da I.Stat

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*Grazie per l'attenzione!*

*I conti dei flussi di materia*

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Istat. Direzione Centrale della Contabilità Nazionale  
Servizio Domanda finale, input di lavoro e capitale, conti ambientali.



**CReIAMO PA**