



POLITECNICO
MILANO 1863

GIORNATA RIFIUTI E LIFE CYCLE THINKING



Assessment on WASTE
and RESOURCES

5. EDIZIONE – 9 MARZO 2021



*IMPRONTA AMBIENTALE DI PRODOTTI IN
PET E PE DA RIFIUTI PLASTICI
RICICLATI*



Società del Gruppo Herambiente



AGENDA



- Goal
- Scope & system boundaries
- Selected Results
- Key learnings



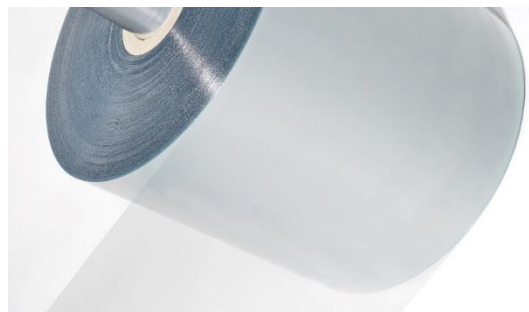
GOAL

To carry out an LCA for the calculation of the **Environmental Footprint** of five recycled plastic products in PET and LDPE from recovered industry scrap and urban waste

- PET: flakes, granulate, sheet
- LDPE: granulate, film



r-PE film



r-PET sheet



r-PET flakes

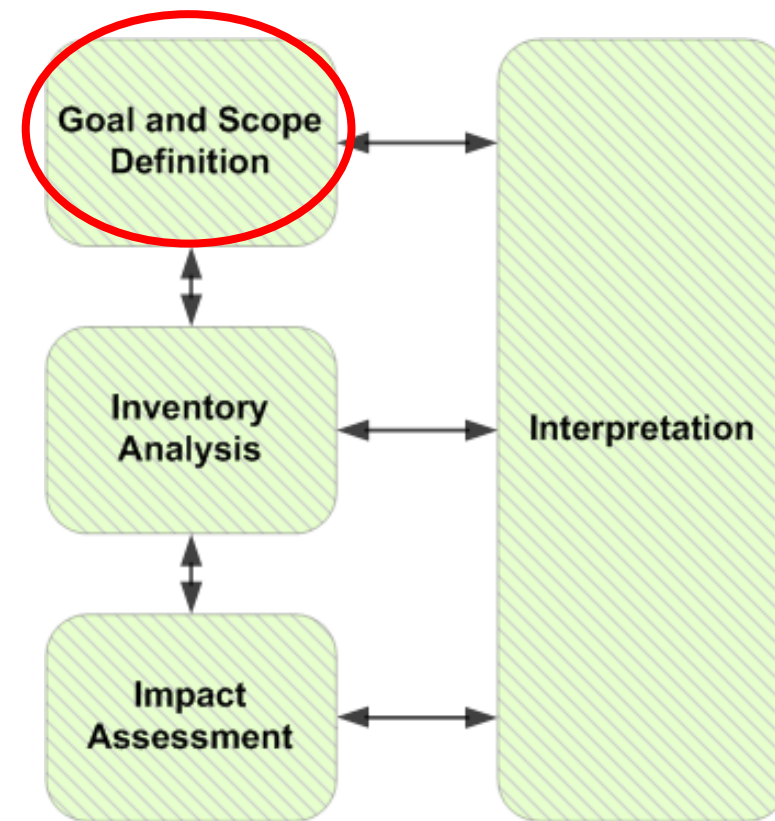


r-PET & r-PE granulate

SCOPE

Step 1 → Goal & Scope definition:

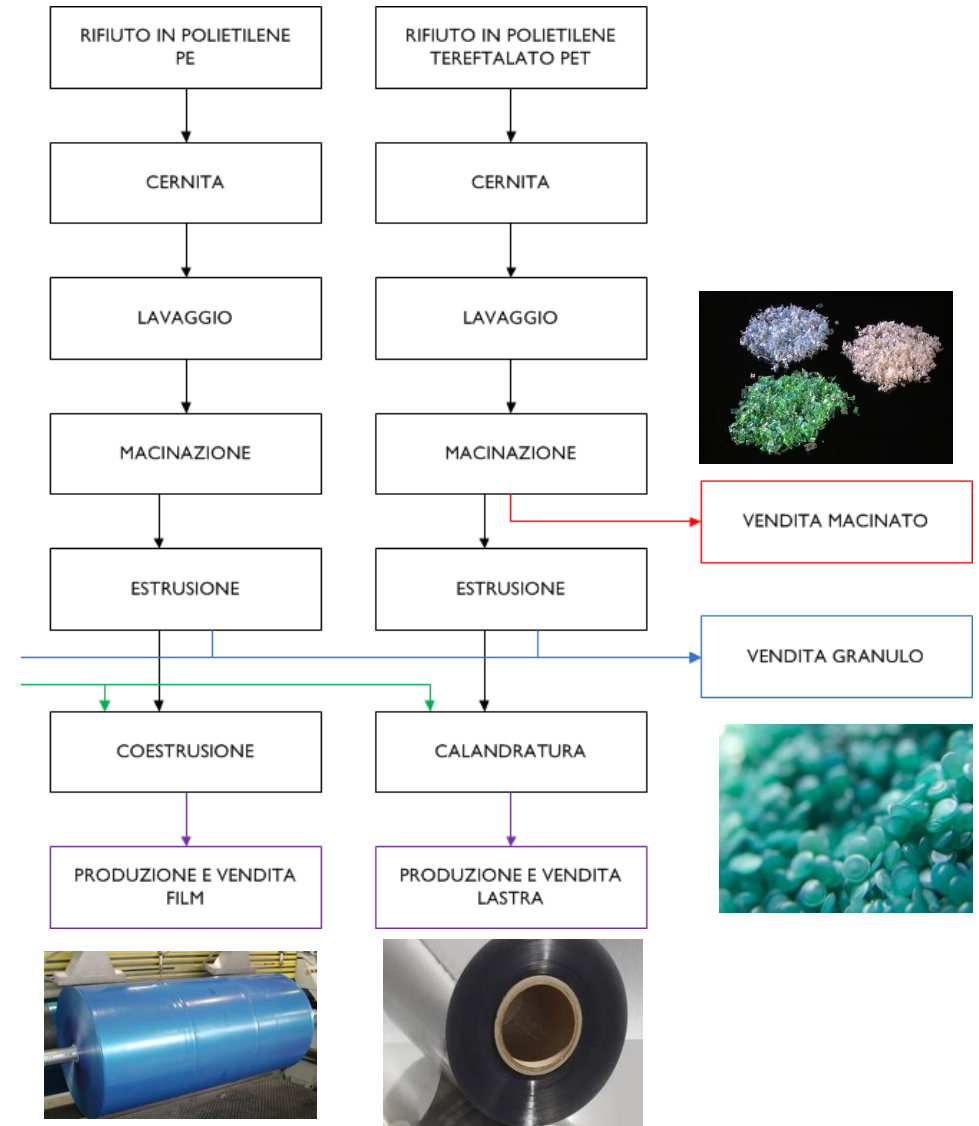
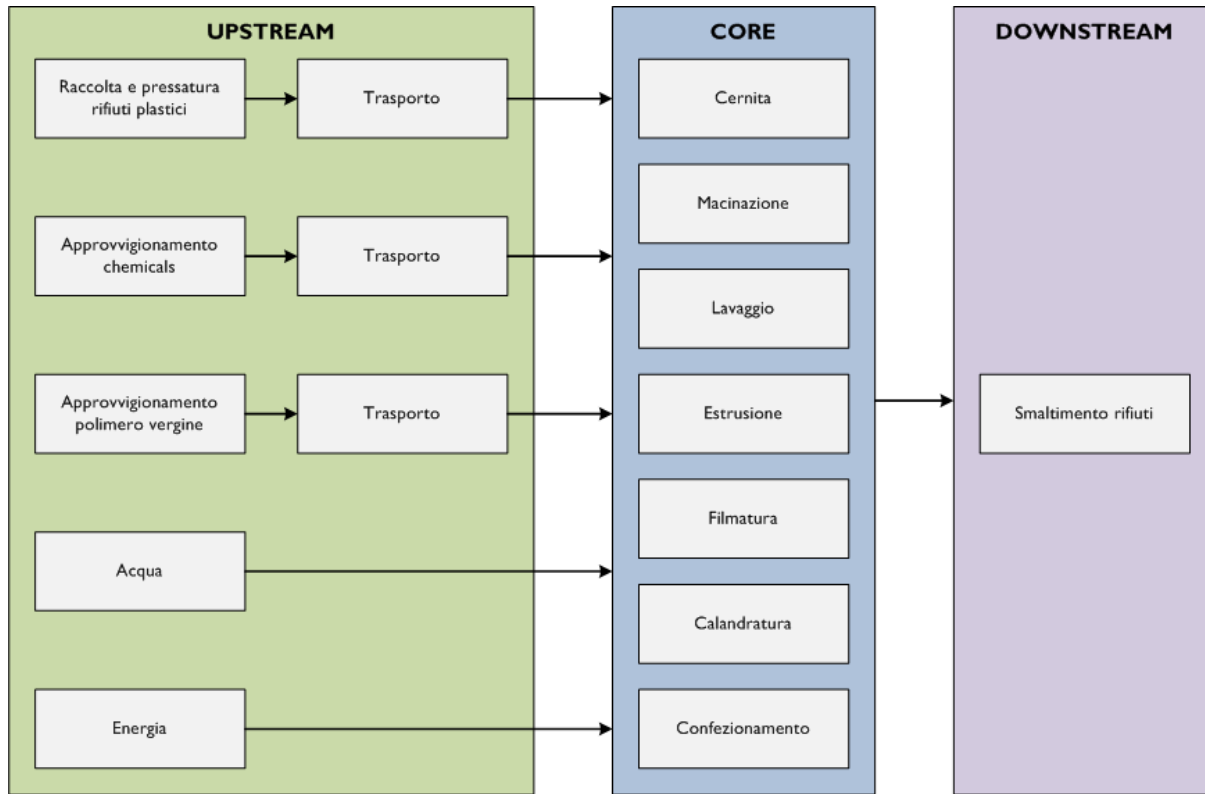
- ❑ Application: EF calculation for marketing and communication
- ❑ Target audience: general public
- ❑ LCIA methodology: European EF v3
- ❑ LCA approach: attributional cut-off (*polluter-pays principle*)
- ❑ Functional Unit (FU): 1 kg product
- ❑ System boundaries: cradle-to-gate, r-PET & r-PE materials/products, ALIPLAST site in Istrana (VE)



LCA framework
(ISO 14040/44)

SCOPE – SYSTEM BOUNDARIES

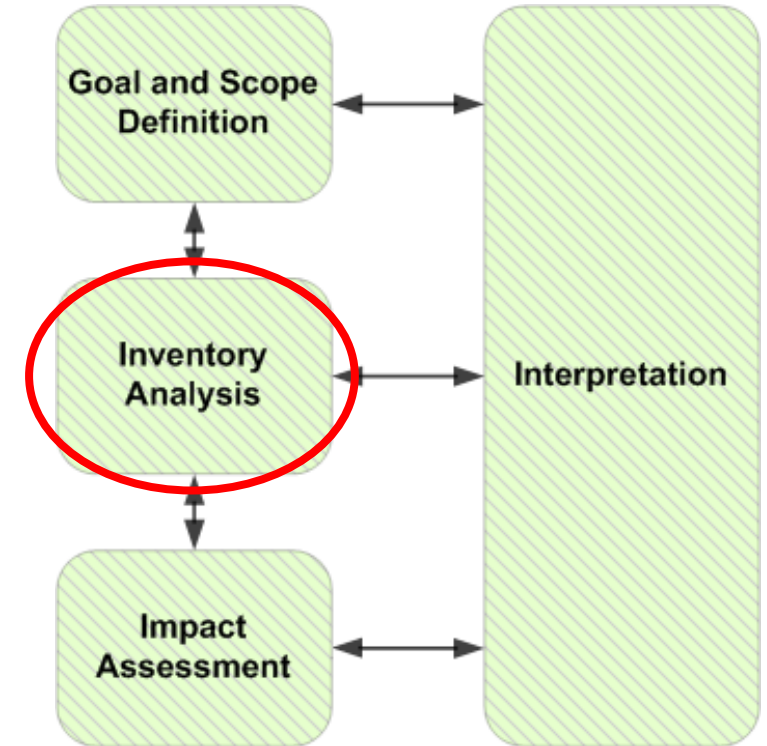
Included Upstream & Downstream processes (G2G LCA)



LIFE CYCLE INVENTORY

Step 2: INVENTORY ANALYSIS

- ❑ Foreground system (Core processes): primary data (2019)
- ❑ Background system (Upstream & Downstream processes): secondary data (Ecoinvent v3.6, ISPRA):
 - Electricity, virgin PE/PET granulate...
 - *Proxy processes*: e.g. peracetic acid → acetic acid;
- ❑ Cut-off criterion: infrastructure and minor material inputs excluded (<0.1%), e.g. filters, additives
- ❑ Allocation: cut-off, mass based

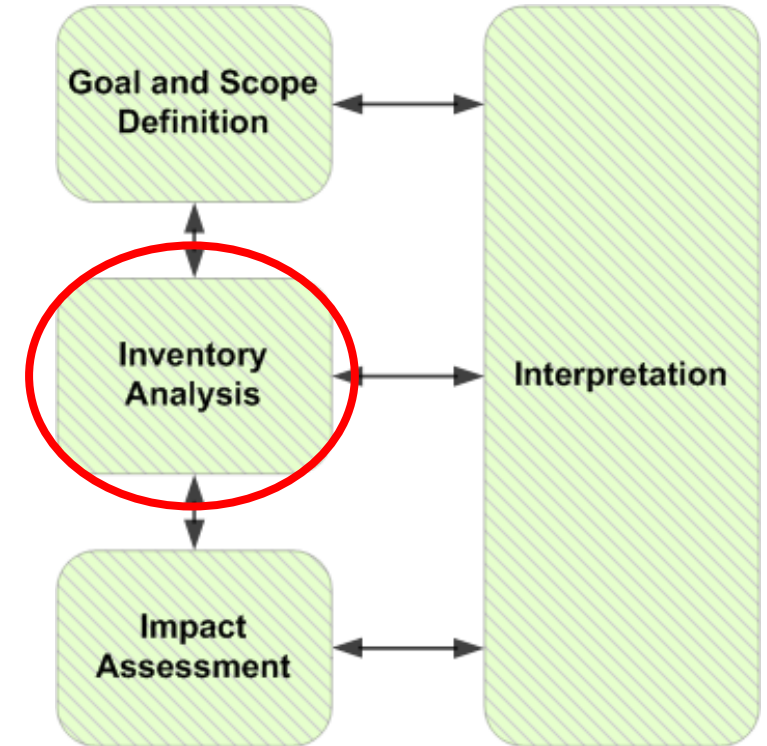


LCA framework
(ISO 14040/44)

LIFE CYCLE INVENTORY

Step 2: INVENTORY ANALYSIS

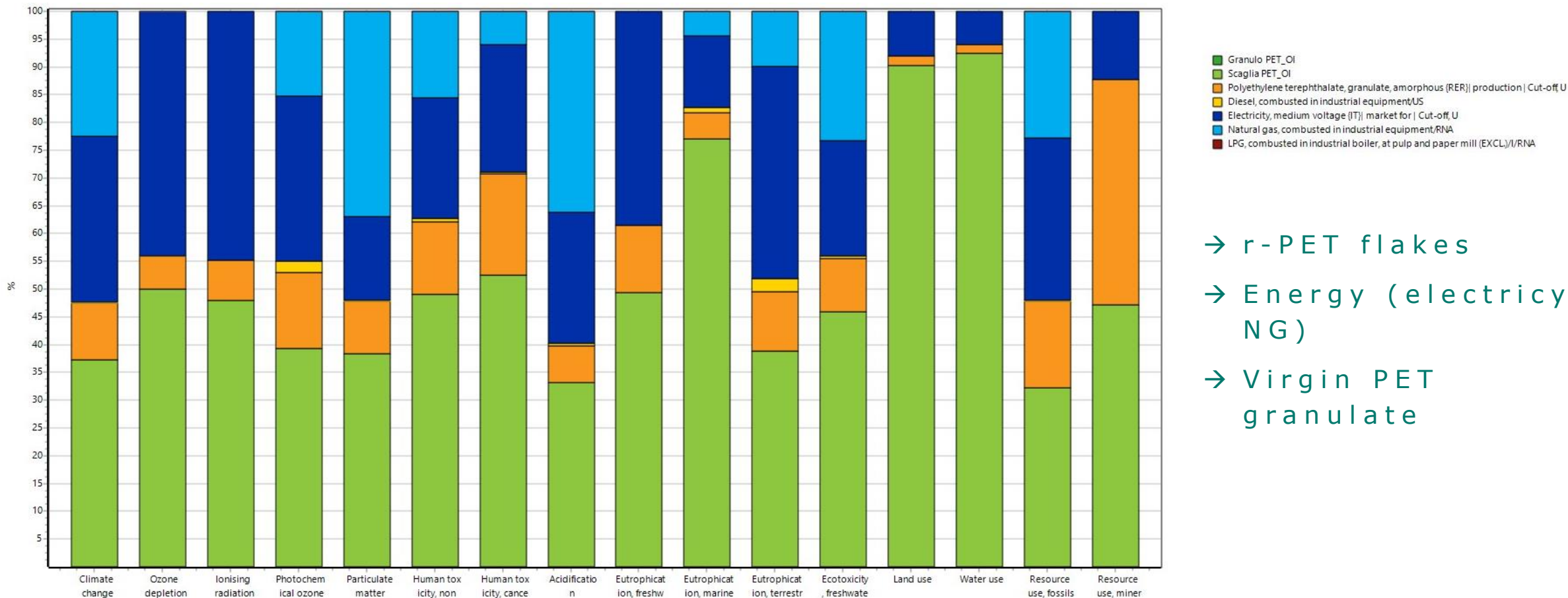
- ❑ Onsite water treatment → mud treatment included, waterborne emissions excluded (wastewater analysis according to regulation)
- ❑ Transport of plastic waste (input) and process waste (output): lorry size + distance (t*km)
- ❑ Waste:
 - Discarded plastics, dirty materials: **incineration**
 - Wastewater muds: **treatment (sludge)**
 - Packaging & other plastic waste: **recycling**



LCA framework
(ISO 14040/44)

RESULTS

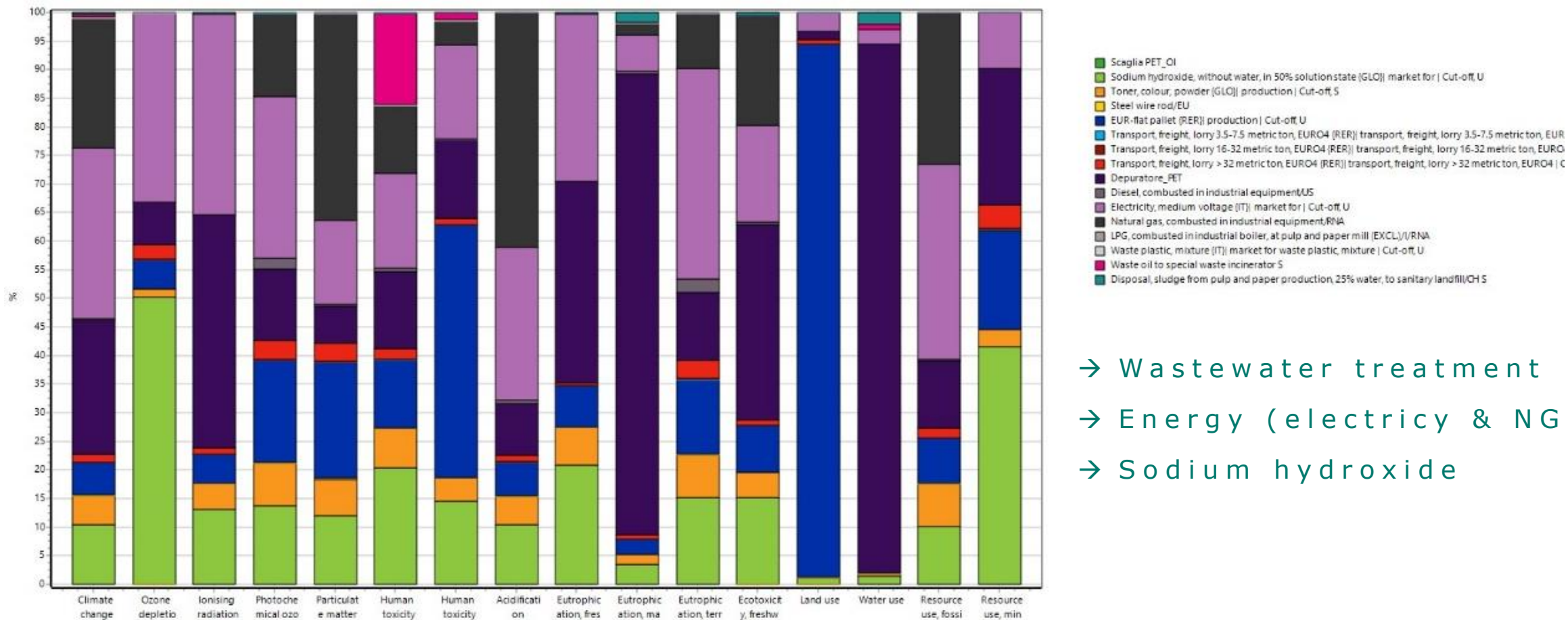
Contribution analysis: r-PET granulate



- r-PET flakes
- Energy (electricity & NG)
- Virgin PET granulate

RESULTS

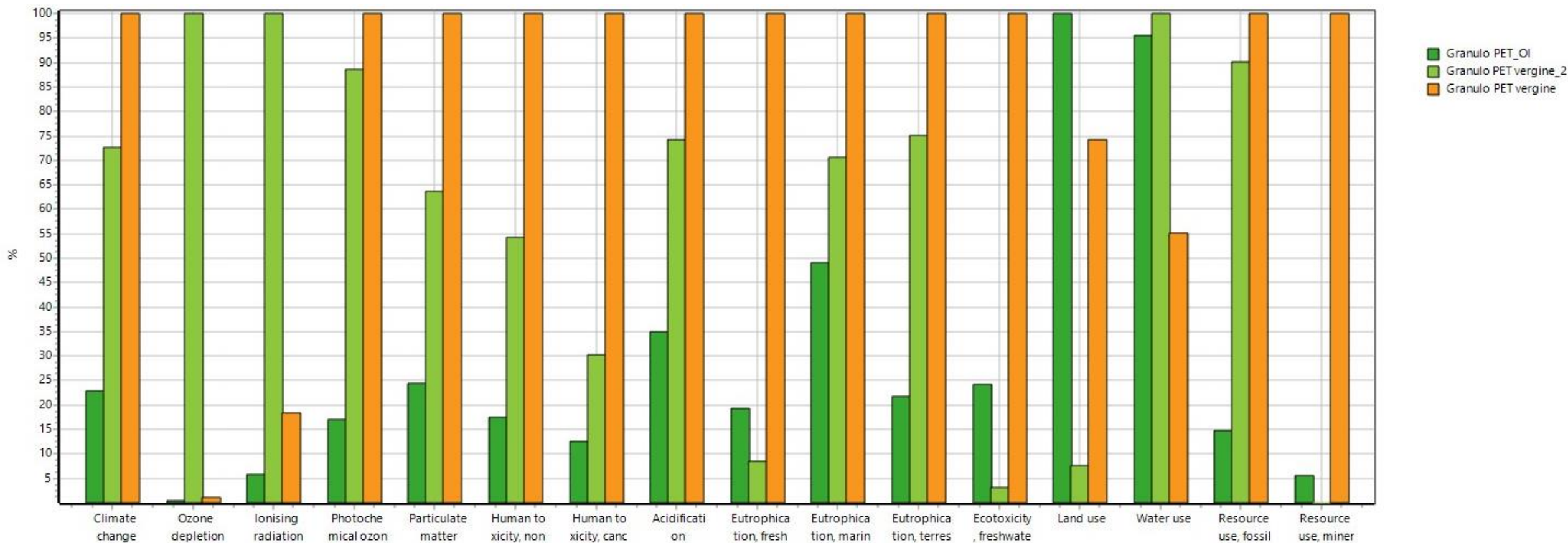
Contribution analysis: r-PET flakes



- Wastewater treatment
- Energy (electricity & NG)
- Sodium hydroxide

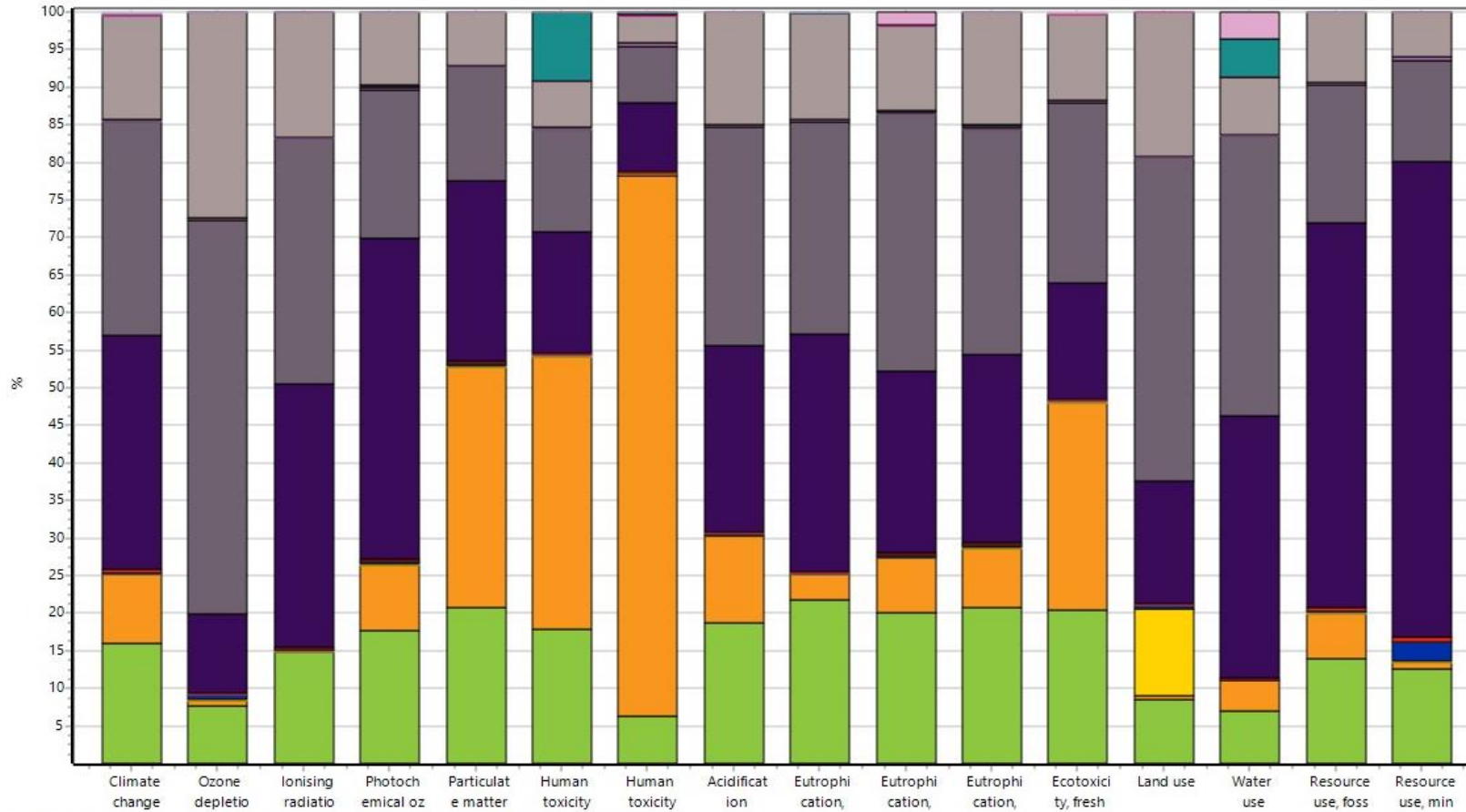
RESULTS

Step 3: LIFE CYCLE IMPACT ASSESSMENT: Selected EF results: r-PET granulate



RESULTS

Contribution analysis: r-PE film

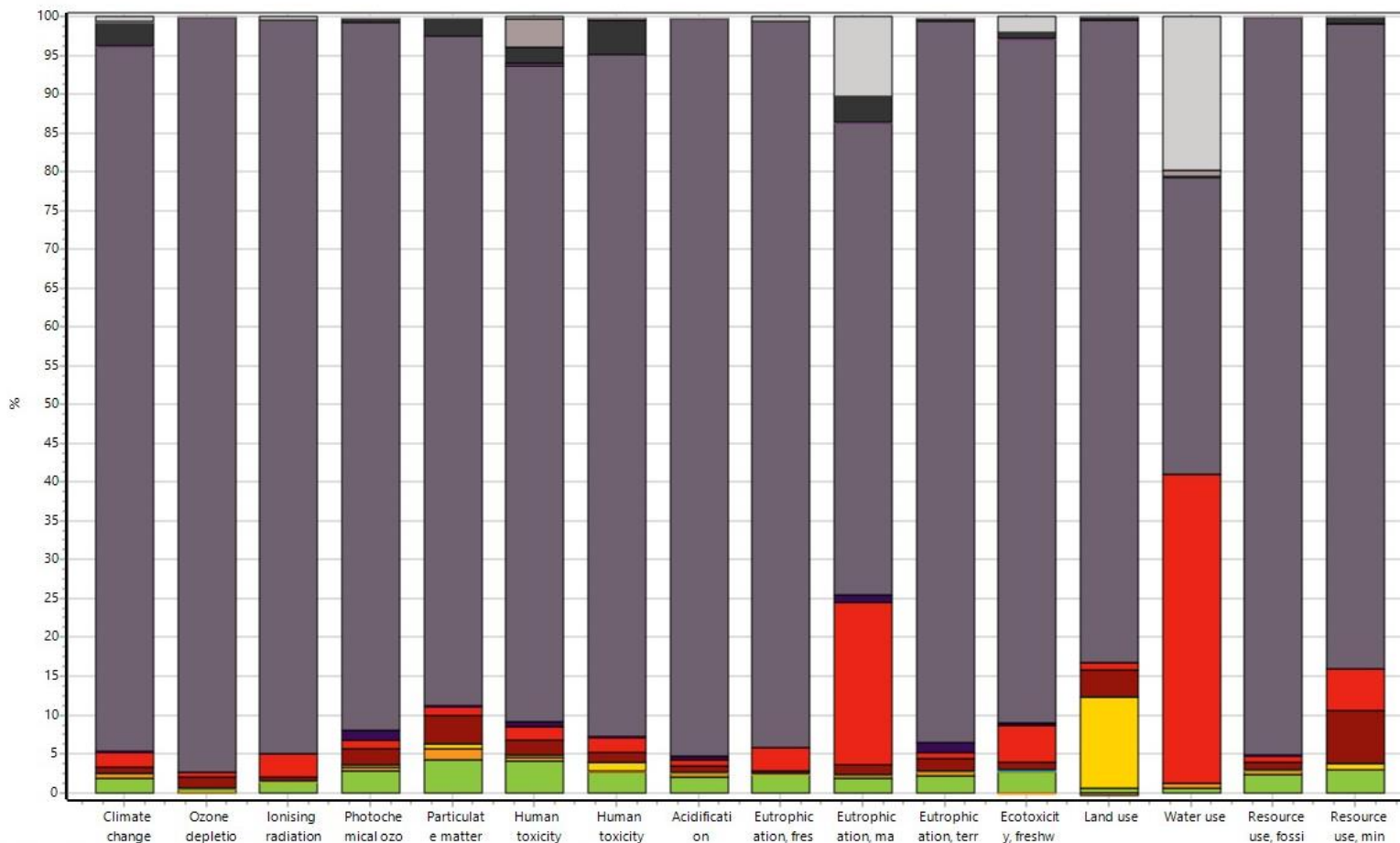


- Film PE
- Toner, colour, powder (GLO) production | Cut-off, S
- Polyvinylidene chloride, granulate (RER) production | Cut-off, U
- EUR-flat pallet (RoW) production | Cut-off, S
- Transport, freight, lorry 3.5-7.5 metric ton, EURO4 (RER) | transport, freight, lorry 3.5-7.5 m
- Transport, freight, lorry 16-32 metric ton, EURO4 (RER) | transport, freight, lorry 16-32 m
- Transport, freight, lorry > 32 metric ton, EURO4 (RER) | transport, freight, lorry > 32 m
- Polyethylene, high density, granulate (RER) production | Cut-off, U
- Polyethylene, low density, granulate (RER) production | Cut-off, U
- Granulo PE
- Chemical, organic (GLO) production | Cut-off, U
- Diesel, combusted in industrial equipment/US
- Electricity, medium voltage (IT) market for | Cut-off, U
- LPG, combusted in industrial boiler, at pulp and paper mill (EXCL)/I/RNA
- Waste plastic, mixture (IT) market for waste plastic, mixture | Cut-off, S
- Waste oil to special waste incinerator S
- Disposal, sludge from pulp and paper production, 25% water, to sanitary landfill/CH S

- Electricity (light grey)
- Virgin & r-PE granulate (dark purple & dark grey)
- Toner (colorant): light green
- Mandrini in PVC

RESULTS

Contribution analysis: r-PE granulate



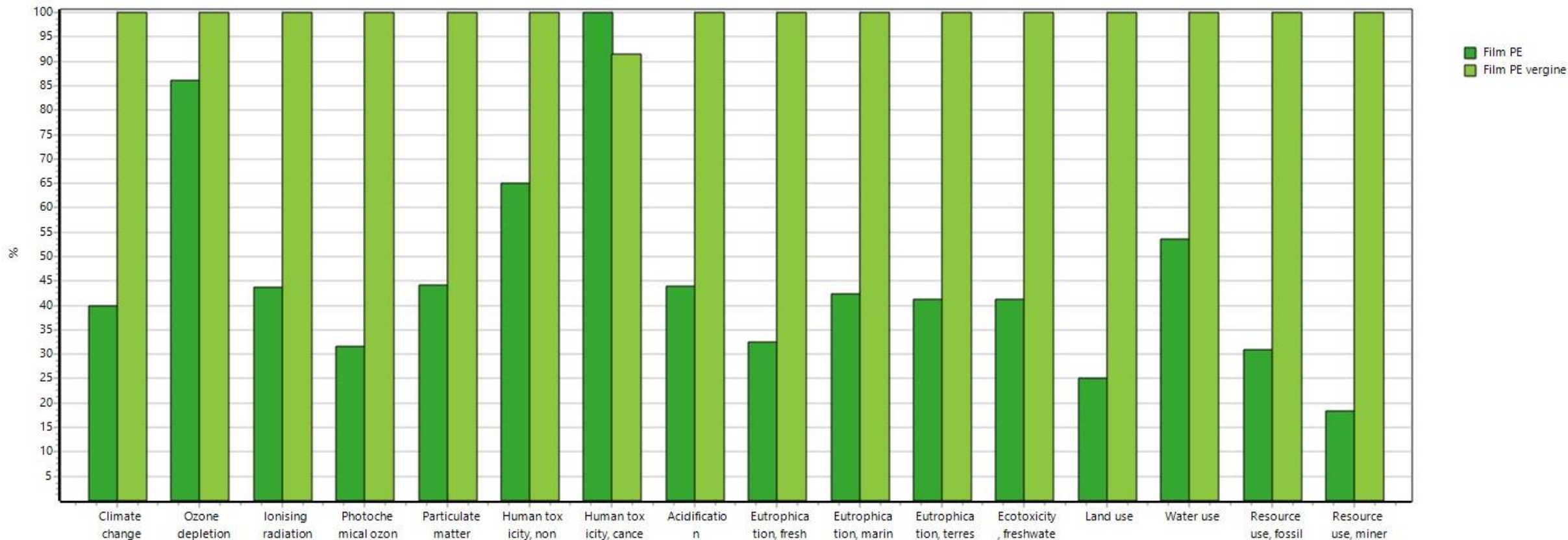
- Granol PE
- Toner, colour, powder (GLO) production | Cut-off, S
- Steel wire rod/EU
- EUR-flat pallet (RoW) production | Cut-off, S
- Transport, freight, lorry 3.5-7.5 metric ton, EURO4 (RER) | transport, freight, lorry 3.5-7.5 metric ton, EURO4
- Transport, freight, lorry 16-32 metric ton, EURO4 (RER) | transport, freight, lorry 16-32 metric ton, EURO4
- Transport, freight, lorry >32 metric ton, EURO4 (RER) | transport, freight, lorry >32 metric ton, EURO4 | Cu
- Depuratore PE
- Diesel, combusted in industrial equipment, US
- Electricity, medium voltage (IT) market for | Cut-off, U
- LPG, combusted in industrial boiler, at pulp and paper mill (EXCL)/I/RNA
- Waste plastic, mixture (IT) market for waste plastic, mixture | Cut-off, U
- Waste oil to special waste incinerator S
- Disposal, sludge from pulp and paper production, 25% water, to sanitary landfill (CH S)

→ Electricity (dark grey)

→ Wastewater treatment (red) & disposal sludge (light grey)

RESULTS

Step 3: IMPACT ASSESSMENT: Selected EF results: r-PE granulate & film



KEY LEARNINGS

Main conclusions:

- ✓ r-PE and r-PET products show much **better** environmental **performance** than the different virgin, fossil-origin counterparts (virgin PET & PE from either Plastics Europe or Industry Data 2.0)
- ✓ The main contribution sources to the EF of r-PE and r-PET products are:
 - % of virgin granulate
 - Wastewater treatment process
 - Energy use (diesel & electricity)

FUTURE WORK

Improvements:

- ✓ Circular Footprint Formula as second allocation approach
- ✓ Process optimization analysis to reduce further the EF
- ✓ Improvement potential through acquisition/investment on RE sources for energy provisioning; chemical use minimization; virgin granulate input
- ✓ Evaluate the possibility to go **C-neutral** in the future:
 - RE certified electricity or on-site RE production, e.g. solar PV
 - Offsetting via local forestry projects, e.g. FSC Italy

GRAZIE! 😊



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