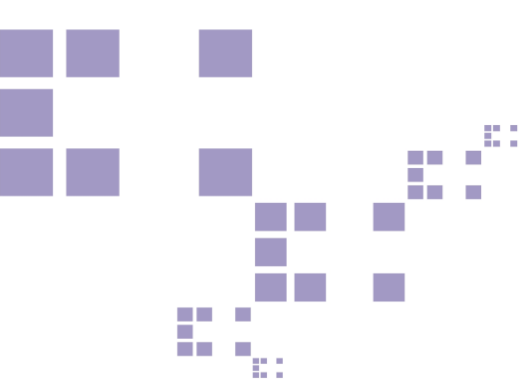




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PET packaging (bottles) flow analysis and management toward circular economy

Monika Raugėvičiūtė

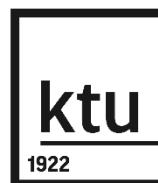
Dr. Daina Kliaugaitė

ME-LOOPS Final Conference

27th September, 2016



University of Applied Sciences and Arts
Northwestern Switzerland



institute of
environmental
engineering



Presentation outline

Relevance and Measures

- Why Circular Economy and plastic packaging?
- What are the main targets/measures for plastic packaging?

Closing material loops

- Efficiency in recycling (closing the loop);
- Good practise and initiatives in EU



Relevance and Targets

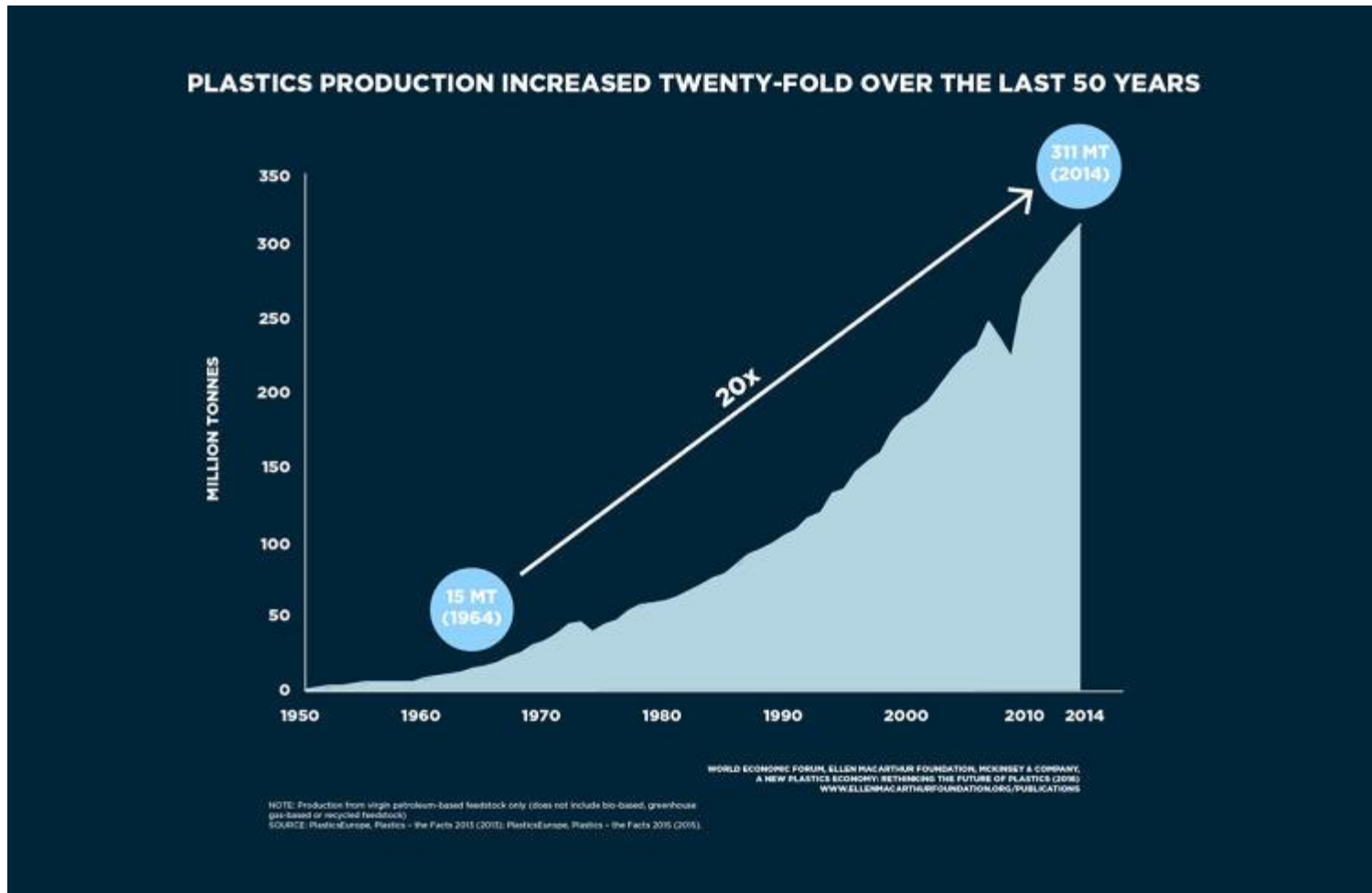
- Why Circular economy, New Plastic Economy and plastic packaging?
- What are main targets/measures for plastic packaging?



Why Circular Economy and plastic packaging?



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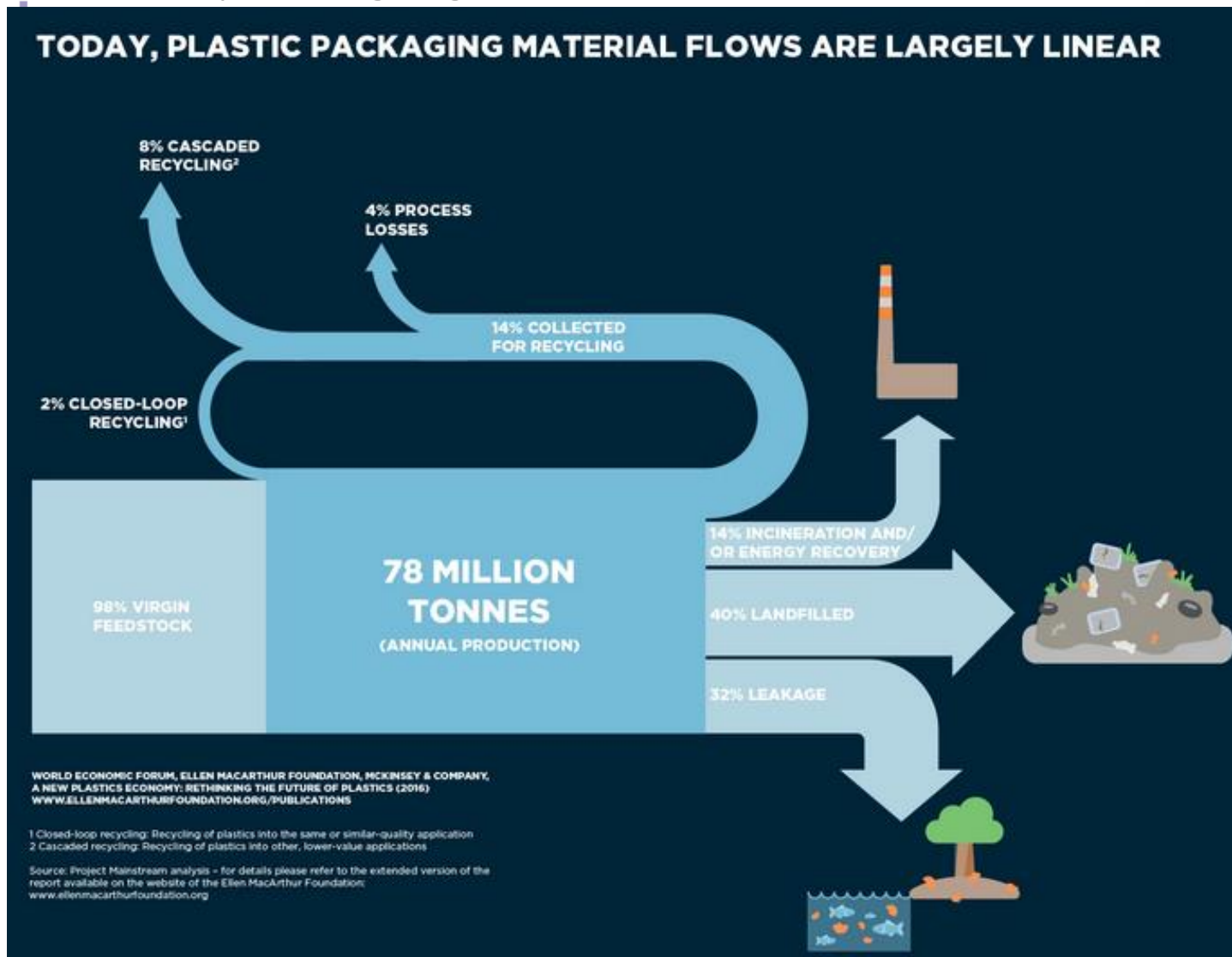


World Economic Forum, Ellen MacArthur Foundation and McKinsey & Company, The New Plastics Economy — Rethinking the future of plastics (2016, <http://www.ellenmacarthurfoundation.org/publications>).

Why Circular Economy and plastic packaging?



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World Economic Forum, Ellen MacArthur Foundation and McKinsey & Company, The New Plastics Economy — Rethinking the future of plastics (2016, <http://www.ellenmacarthurfoundation.org/publications>).



Negative externalities

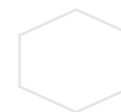


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Degradation of
natural
systems: ocean

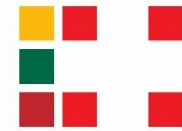
Greenhouse-
gas
emissions

Health and
environmental
impacts from
substances of
concern

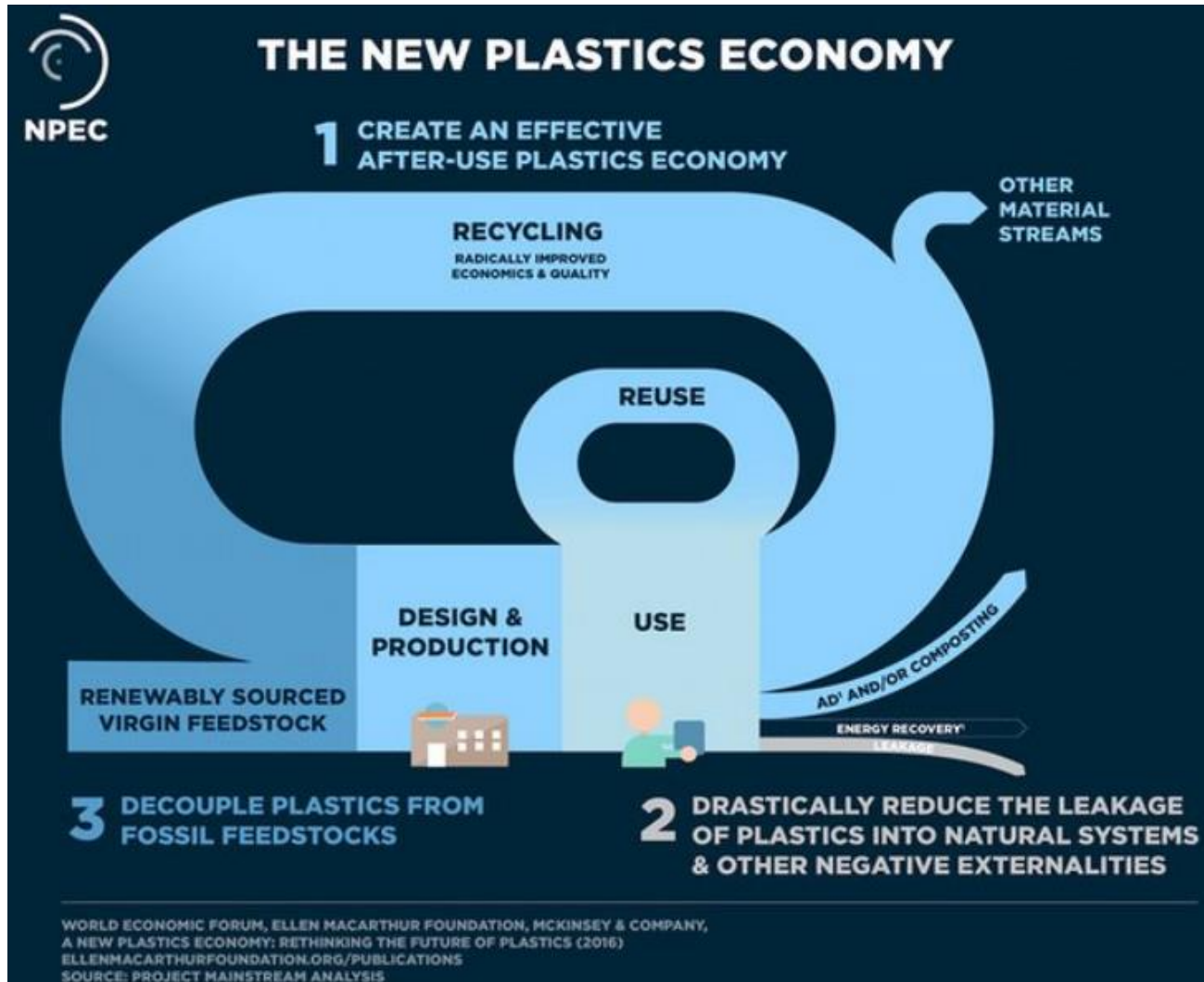


New Plastic Economy

(Ellen Macarthur foundation and World Economic Forum, 2016)



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World Economic Forum, Ellen MacArthur Foundation and McKinsey & Company, The New Plastics Economy — Rethinking the future of plastics (2016, <http://www.ellenmacarthurfoundation.org/publications>).



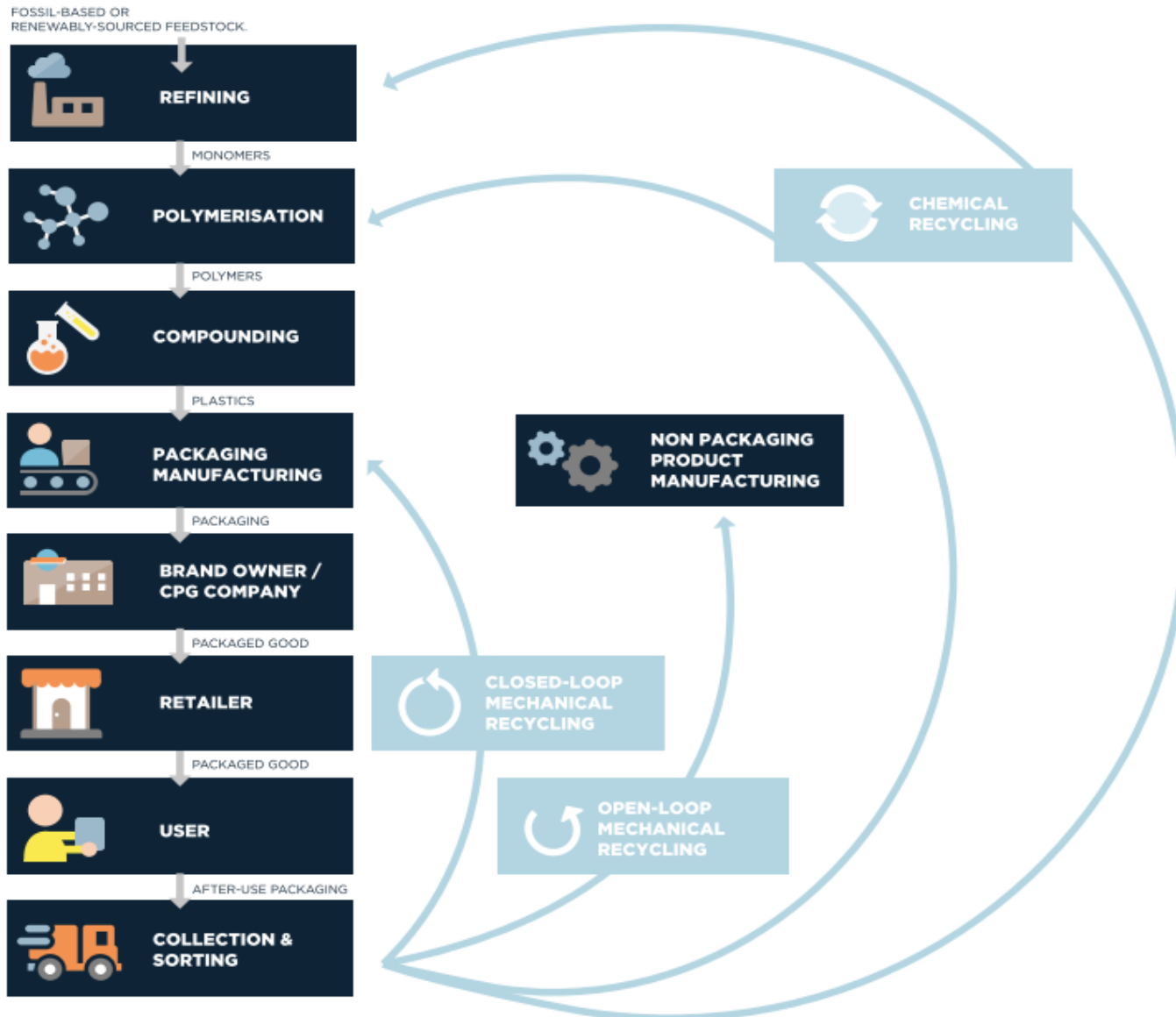
Closing material loops

- Efficiency in recycling (closing the loop);
- Good practise in EU and Switzerland;

Closing material loop



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3 types of
PET
recycling

PET bottle recycling



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- PET is the most recycled plastic packaging material in Europe.
- The PET resin recycling rate in 2012 was 52.3%;
- approximately half of the available rPET resin is either incinerated or landfilled;
- Use of rPET **in fibre** and sheet applications was around 50/50 with virgin PET in 2013;
- **rPET for bottle to bottle (B2B) applications has grown from 25.3% in 2011 to 28.4% in 2012. The average recycled content in PET bottles in Europe is now 10.6%.**
- 1.68Mt PET bottles were collected in 2012 for recycling. This is an increase of 5.6% compared to 2011.
- Close the recycling loop and therefore save 1.5 tonnes of CO₂ for every 1 tonne of rPET used in place of virgin PET (**WRAP**).



Good practice in Europe PET



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Germany

- 97% - collection;
- 80% - recycling occurs
- B2B - 30%
- B2F - 70%

Sweden

- quota PET bottles recycled
- 83,5 % recycling rate
- B2B quota undefined

Netherlands

- in 2018 :
 - average of 37 per cent
 - should be and 32 per cent

United Kingdom

- Matrica for bottle design

Working together for a world without waste			
	Category A (ideal)	Category B (not ideal / not detrimental)	Category C (detrimental)
Colourants	Clear / no colour / natural; Colour light blue/green or other light colours and tints only	Colour - Strong tints dark blue/green/brown	Dark or solid colours; Opaque white and others; Opaque black; Metallic colours; and use of fillers.
Barrier coatings & layers	No barrier/coating layers; Plasma coatings e.g. Chemical Vapour Deposition; SiO ₂ Monox/Monobar; Other blended additives/processing aids; Other PET based carriers	PEN barrier layer (if <3% total bottle weight) Amasorb barrier layer (if <3% total bottle weight)	EVOH / Amasorb / MXD6 Any nylon based barrier layers
Closures	HDPE/ LDPE/ PP		Metals / PS / PVC; Any other materials density >1g/cm ³
Closure liners and seals	No closure liners; HDPE, PP, PP+EVA/EVOH; PE+EVA/EVOH; EVA or EVOH if it floats i.e. density <1g/cm ³	Foamed PET; Paper; Silicone 'swimming' valves (density <1g/cm ³); Any other closures which float after granulation	Metal / PVC / EVA / Silicone / Neck foils of density >1g/cm ³ Any other material of density >1g/cm ³
Labels	No label; HDPE / MDPE / LDPE / LLDPE / PP / OPP / EPS / PET	Paper labels	Pressure sensitive; Self-adhesive labels; PVC / PS / Metallised labels
Sleeves	No Sleeve; PE / PP / OPP / EPS / foamed PET sleeves with density <1g/cm ³ and showing at least 40% of the bottle. Other films of density <1g/cm ³	PET sleeves; Full body shrink sleeves showing <40% of bottle; Full body shrink sleeves – fully colour printed	Contains any PVC Contains any Polystyrene (PS) Any other materials of density >1g/cm ³
Adhesives	No adhesive; Water soluble in 60-80 °C Plastic wrap, minimum glue e.g. lap join	Strong adhesives with paper labels Around 50% of adhesive not removable	Water insoluble (even at elevated temperatures and/or pH); Any non-removable glues
Base Cups	No base cup	HDPE / PP / clear PET	Coloured PET and other plastics density >1g/cm ³
Other components & bottle size	No other components Diameter > 50mm, length >100mm	Diameter 40 – 50mm, length < 100mm	Any polymer with density >1g/cm ³ PVC / PLA / PS / PETG Diameter < 30mm, length < 100mm



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Good practice in Europe

Approved and Non-Approved Material for Swedish PET Bottles



NO! Image of 100% v-PET and 100% r-PET Bottles

CAP
Thermoset
PS
PVC
Metal

**LINER M
AND AD
SEALING**
PVC
METAL

BOTTLE
Coated





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PET packaging (bottles) flow analysis and management toward circular economy

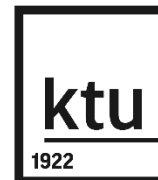
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Presentation outline

Current situation analysis in LT

- Situation in Lithuania; Deposit system;
- Opinion of different stakeholders from PET supply chain

LCA case study and results

- Environmental load using different PET waste management scenarios;
- Environmental load of different design PET bottles

Conclusions and remarks

- Barriers and possibilities in Lithuania for PET recycling
- Solutions for Lithuania to achieve closed-loop recycling?



Current situation analysis in LT

- Situation in Lithuania;
new deposit system;
- Opinion of different
stakeholders from PET
supply chain



Current situation analysis



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Collaboration
with **PET preform**
producer

JSC
Putokšnis

PAKTA

Collaboration with
Packaging
management
association

Questionnaire for
manufacturers, importers,
collectors, recyclers,
exporters, departments of
regional waste managers

Survey

JSC
Akvavita

Collaboration
with **PET bottle**
producer -filler

Statistical
data; waste
accounting
data

Flow
analysis

Materials
flow analysis



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Situation in Lithuania

- Around **15 000** tonnes PET bottles **per year** are released to LT market
- PET used/exported 34,4 % (5201, 9 t) → 2014 m.
- Recycled to lower quality product (down-recycling) or incineration;

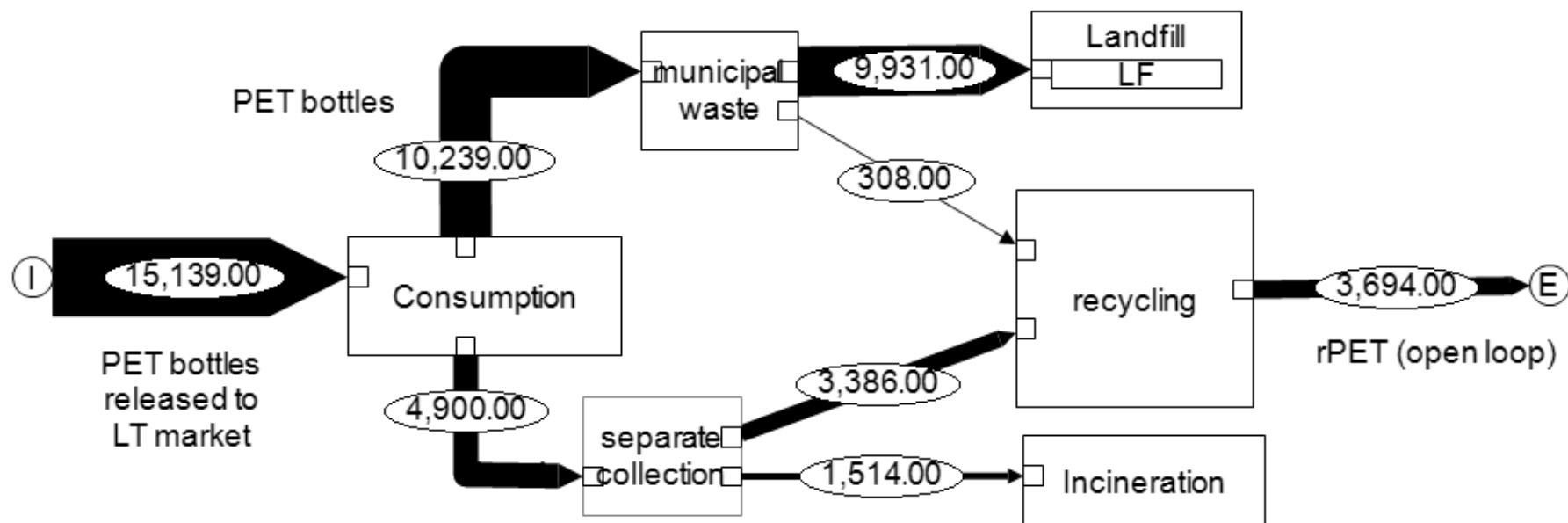
PET packaging goals		
PET packaging	Waste management	Used/exported from released to LT market amount , %
2016	Used/exported	50
	From it Recycled	45
2017	Used/exproted	50
	From it Recycled	37



Situation in Lithuania- flow analysis, 2014

Landfill	65,6 %
Down-recycling	24,4 %
Incineration	10 %

**34,4 % PET
used/exported**





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PET recycling system in Lithuania

2016 still three collecting streams:

1. **2016** one way deposit system - Organised by Deposit system administrator (Užstato sistemos administratorius - USAD)
2. Separate collection (containers + additional -eco-dot)
3. Municipal waste containers



In future (2020) it is planned only **deposit system**

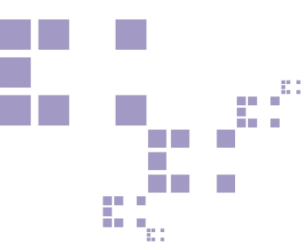
This deposit amounts to 0.10 € per disposable beverage container



Deposit system administrator (USAD)



collection, sorting, transportation and sales of PET bottles



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Deposit system plans

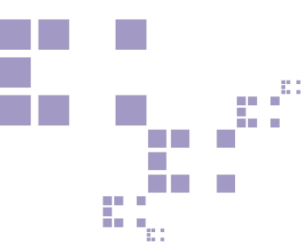
Deposit system plans:

- 2016- collected from deposit system 6000 t
(about 30% from 15000 tonnes released PET)
- 2020 – collected from deposit system (about
83-90% from 17000 tonnes released PET)

Where is going further...downcycling, upcycling
and what benefits from it?

Deposit system is one of the prerequisite for
Bottle-to-Bottle system, because of high collection
rates and good material quality.





Information/opinion from different stakeholders



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- Collected and prepared for recycling PET bottles from deposit system will be sold in the auction.
- Targets are set for collection and recycling amount rates, only, no concern where is going further.
- In Lithuania no recycling plants for rPET food quality (it is one in Latvia).
- 2 PET preform companies could produce preform with rPET, but no market demand (today rPET 15% more expensive than vPET)
- NO any concern about bottle-to bottle from industry and authority

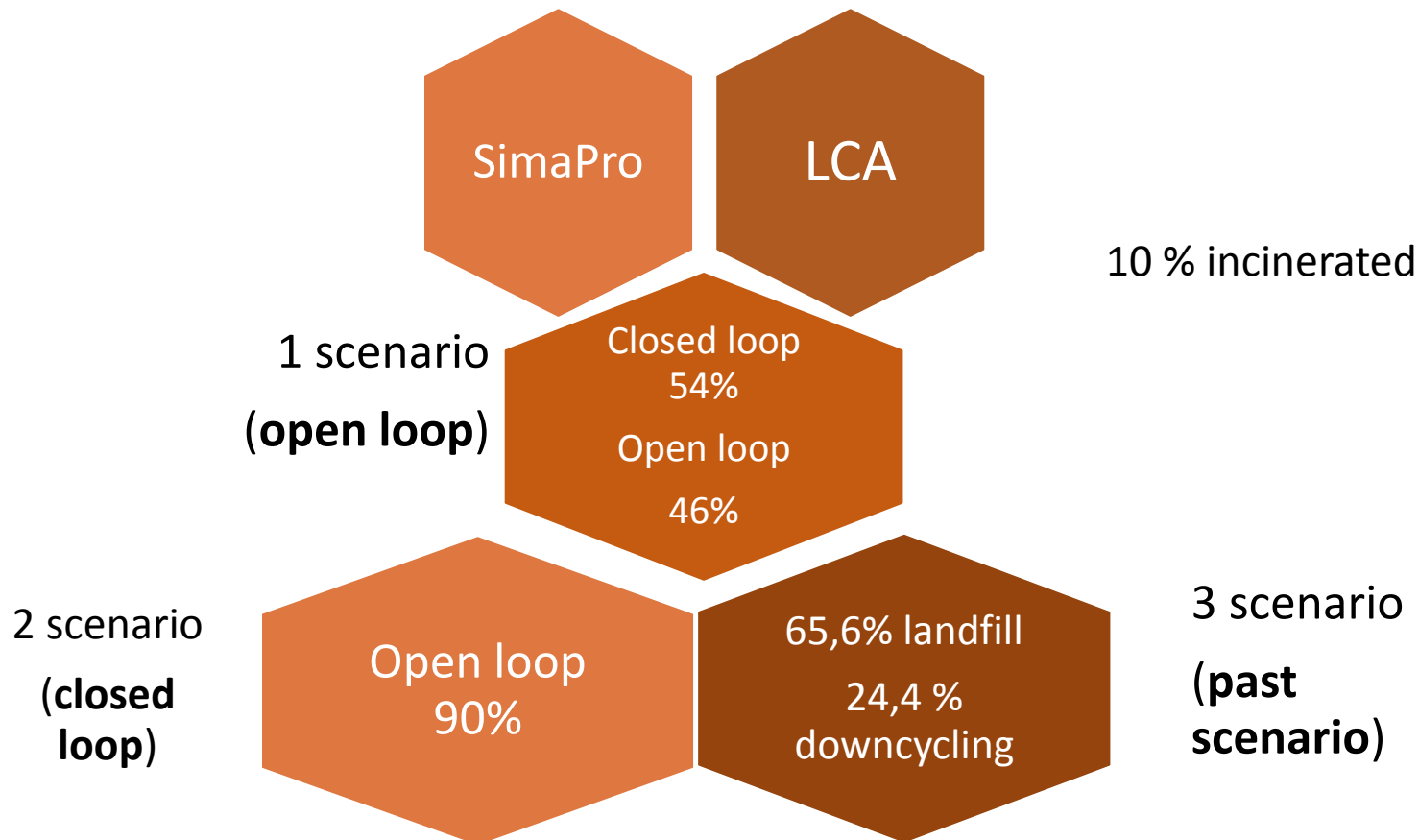


LCA case studies and results

- Environmental burdens using different PET waste management scenarios
- Different PET bottle design LCA

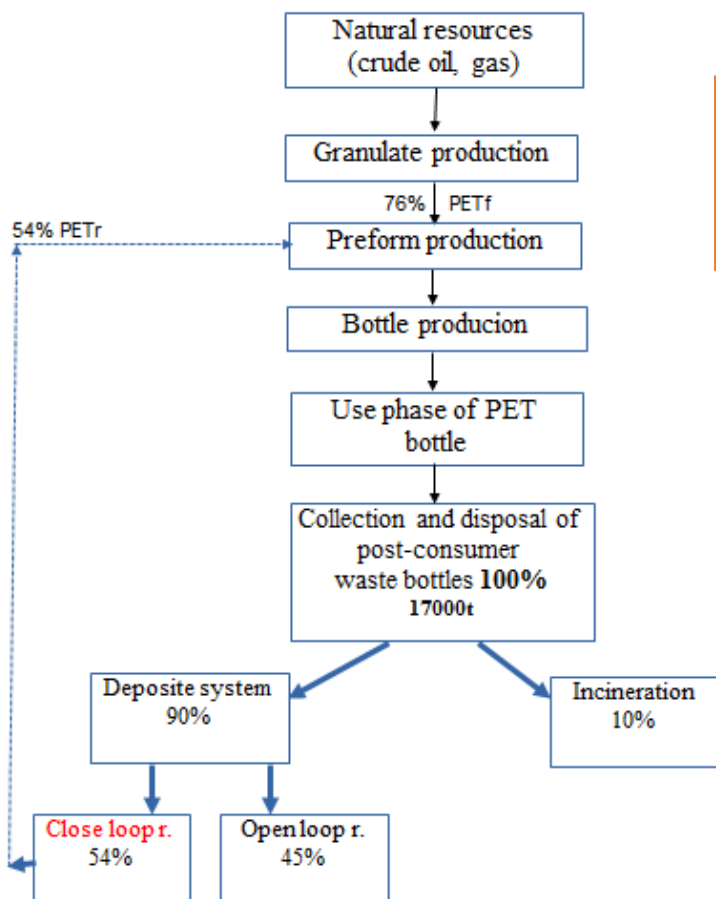


Case study: different waste treatment scenarios





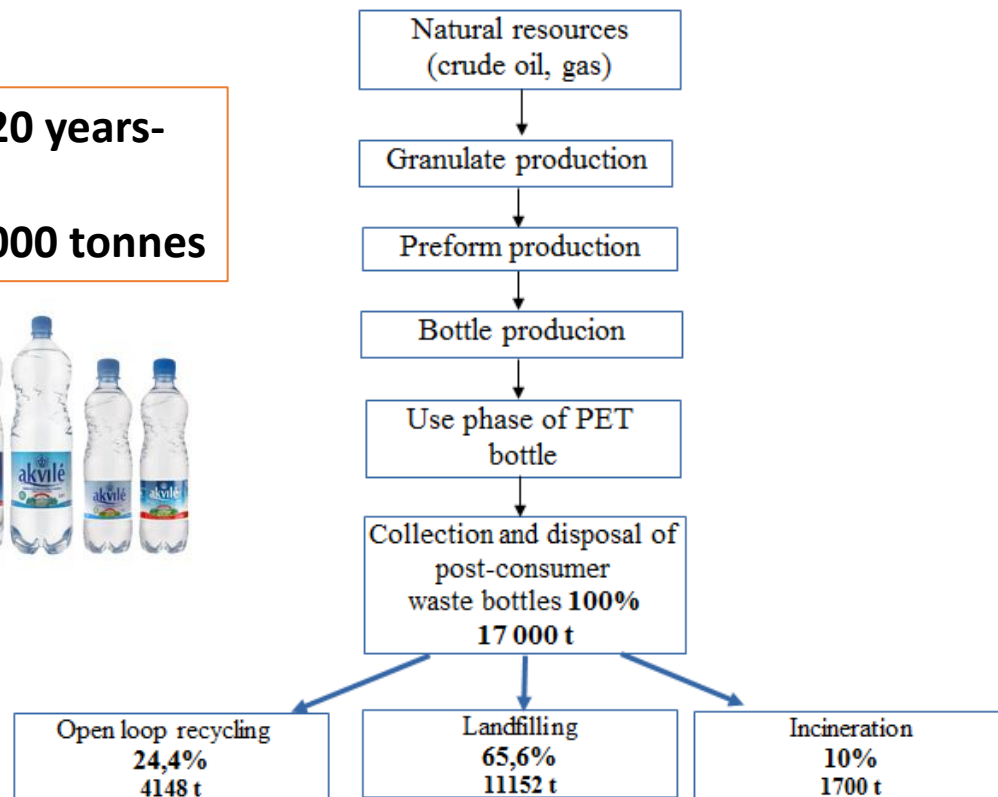
Closed loop



2020 years-
17000 tonnes



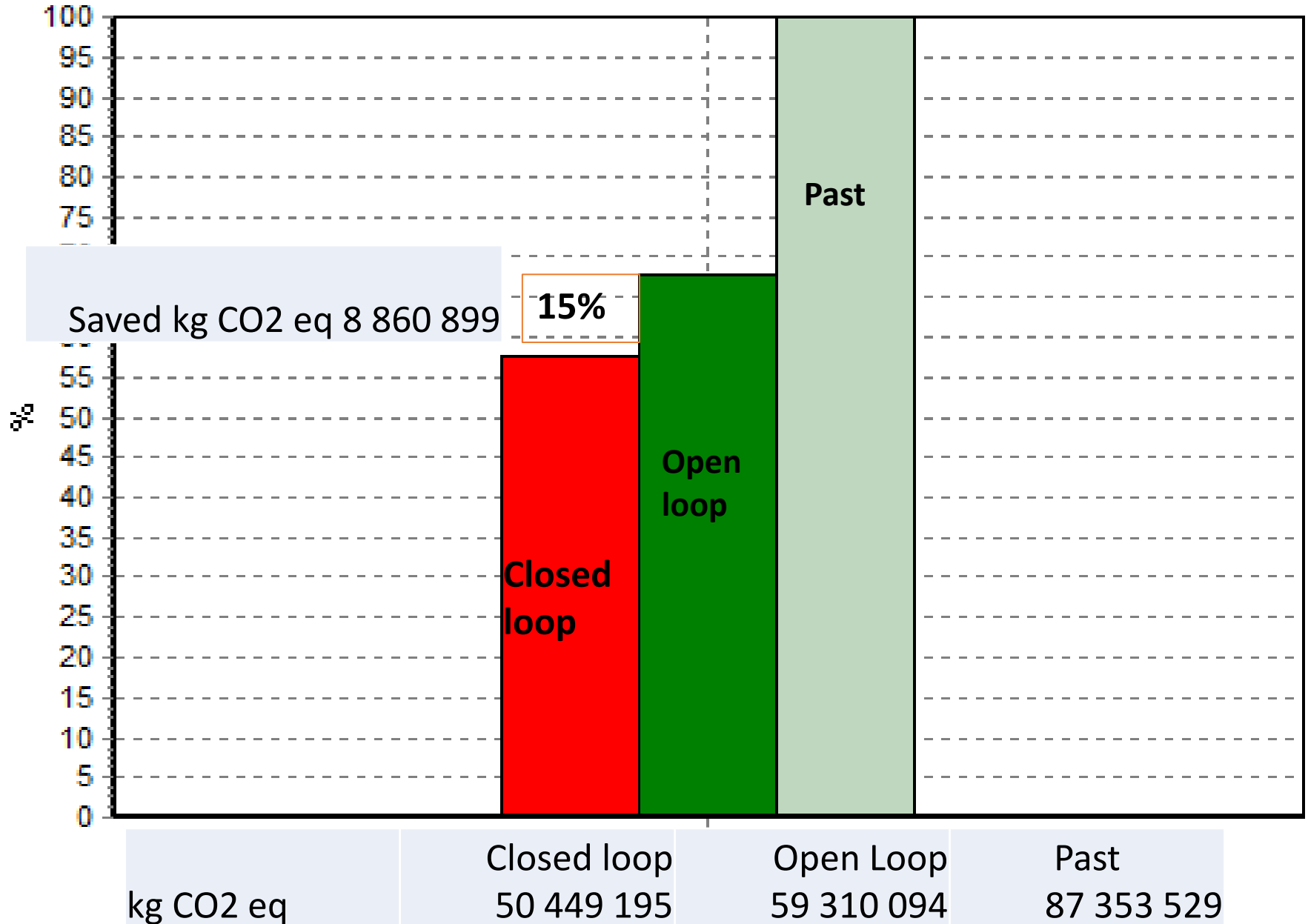
Past



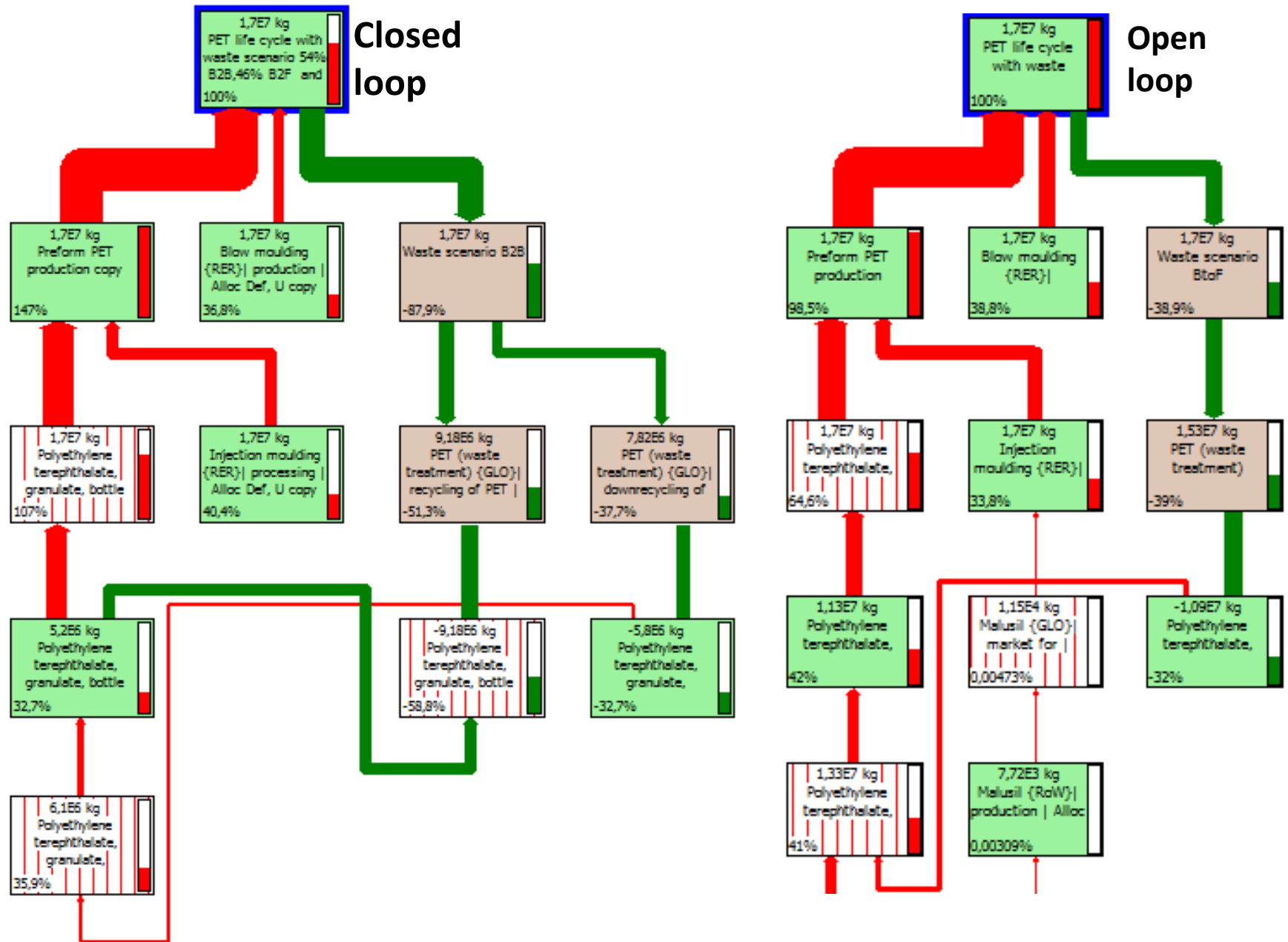
Open loop



IPCC GWP 100a Characterization

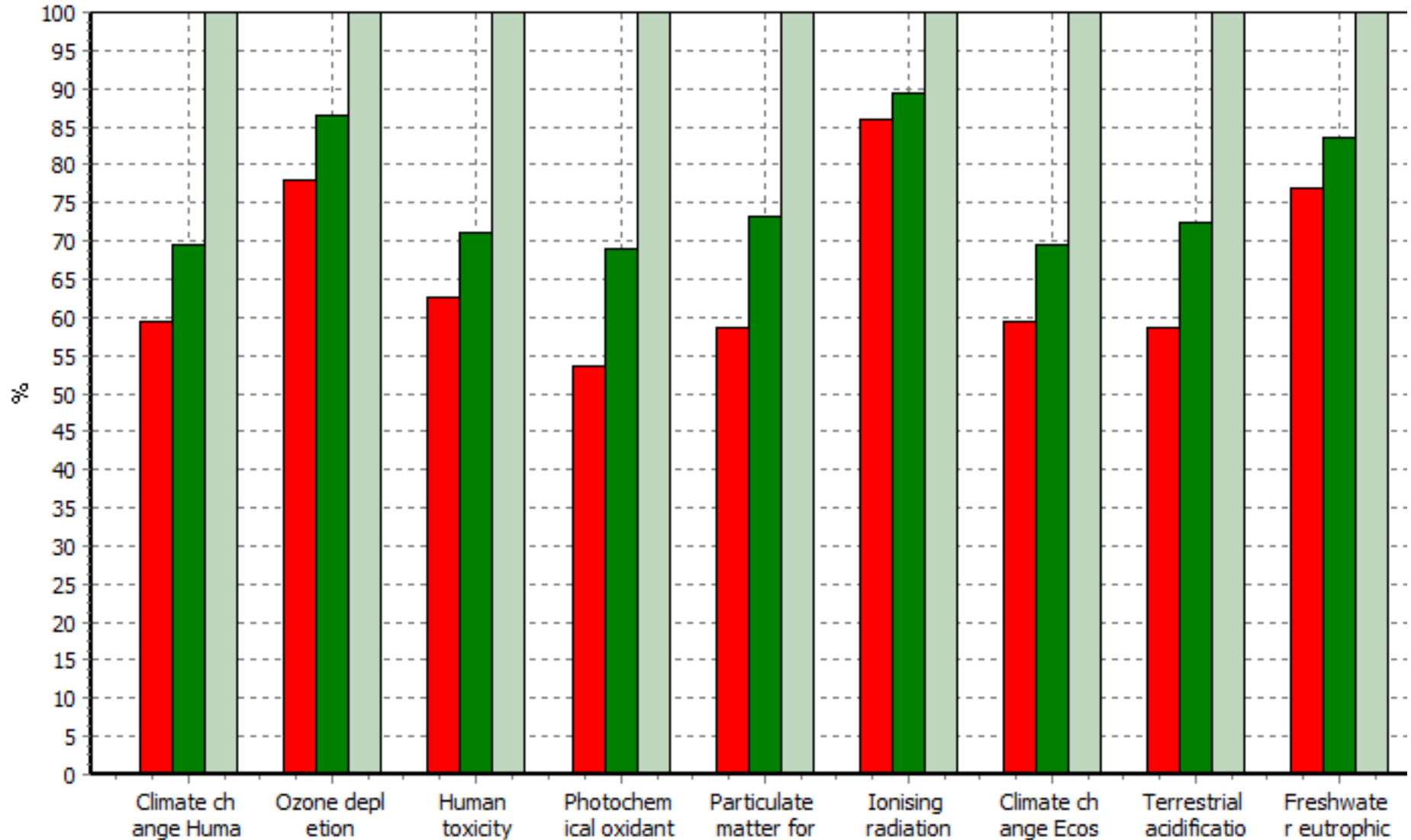


IPCC GWP 100a, Flows models, 22% cut-off

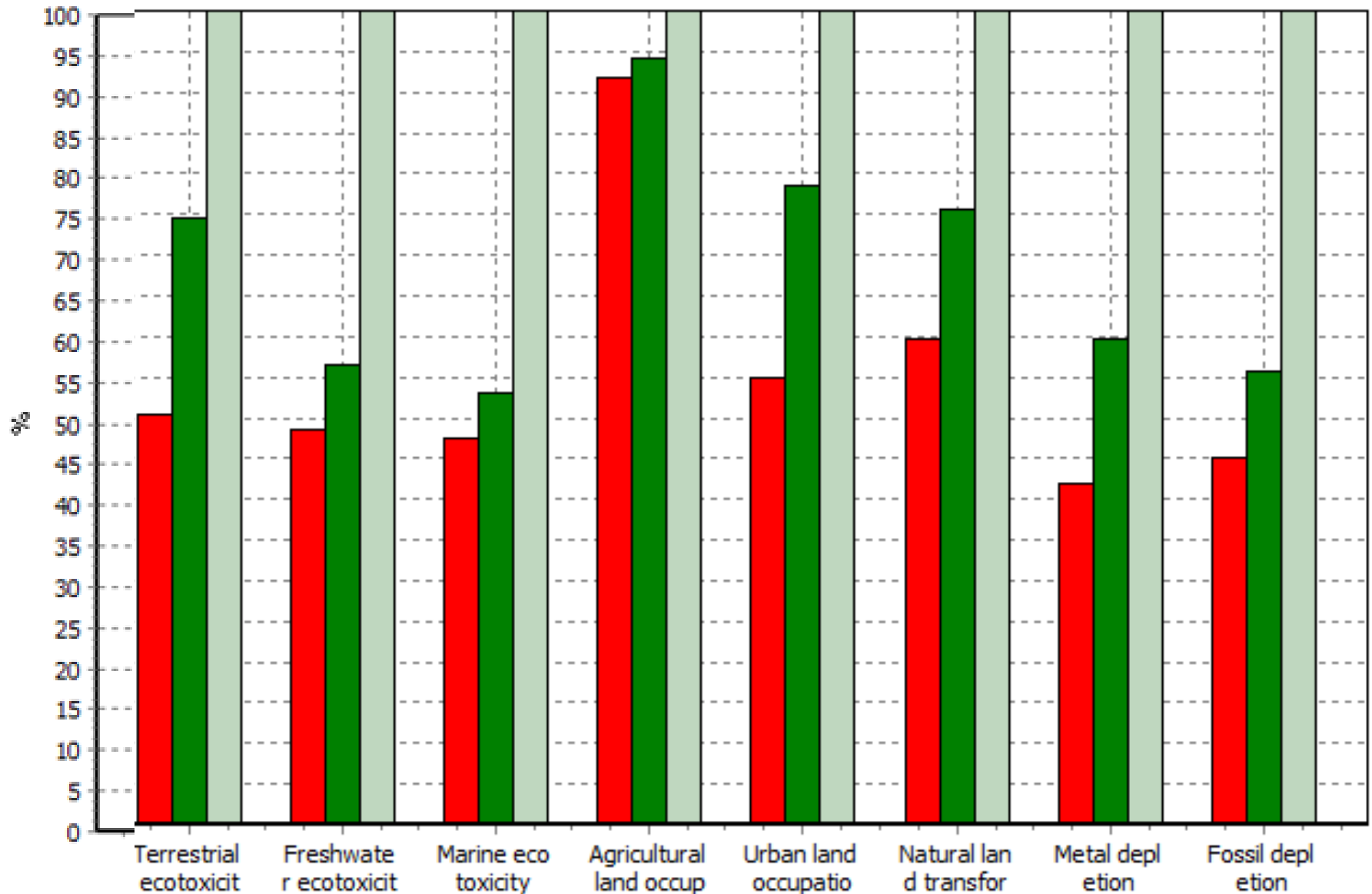


ReCiPe Endpoint (E) V1.11 Characterization

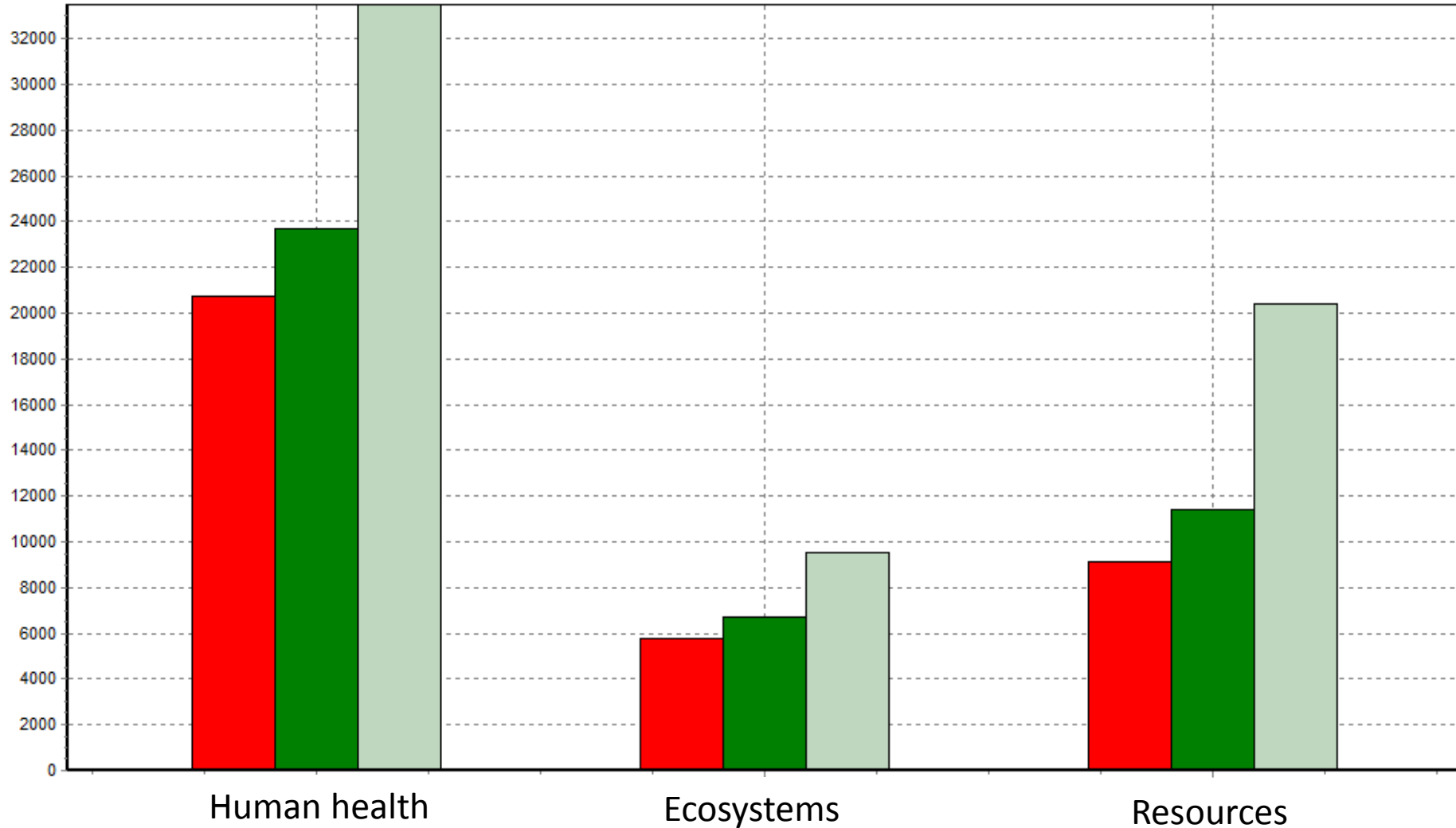
Impact categories



ReCiPe Endpoint (E) V1.11 Characterization

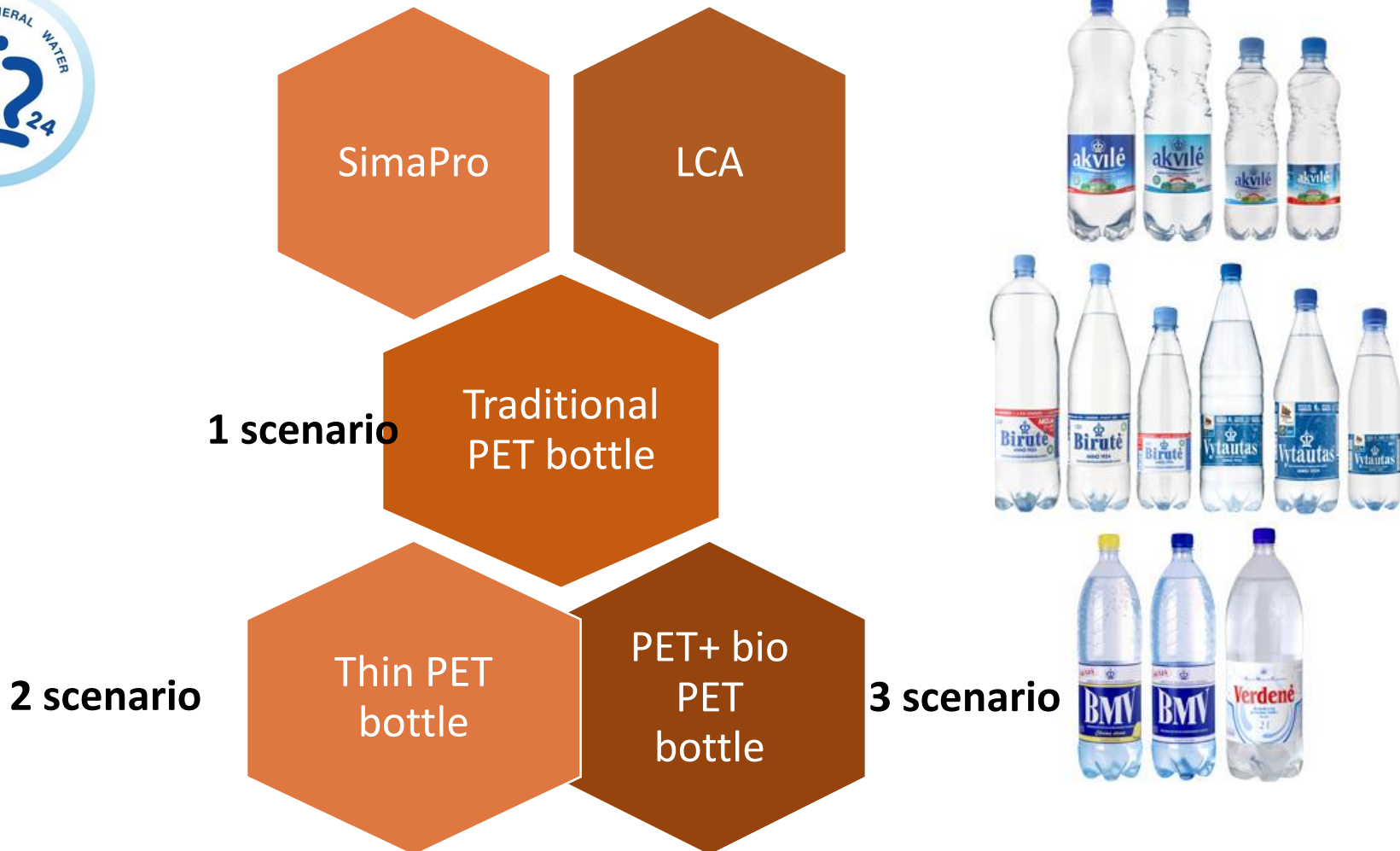


ReCiPe Endpoint (E) V1.11 Normalization Damage Categories





Case study: different bottle design





Goal and scope definition **PET case**



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Goal: Compare environmental performance of different design of PET bottles/

To identify the most important factors that decide environmental impact of PET bottle during the life cycle.

Functional unit: safe deliver one bottle of water (1,5 L or 0,5 L)

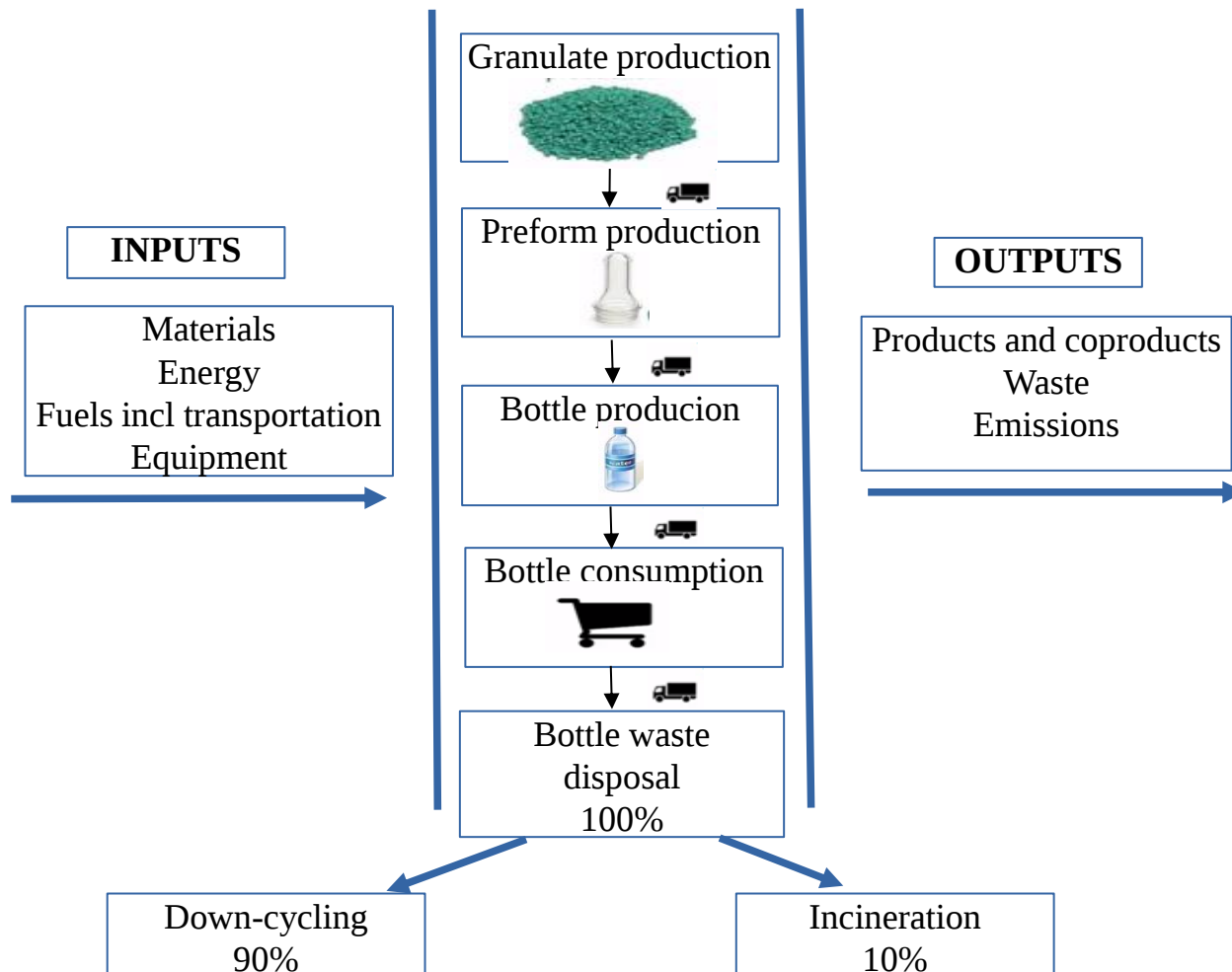
System boundaries: cradle to grave, but water production, filling, labels, caps, packaging excluded.



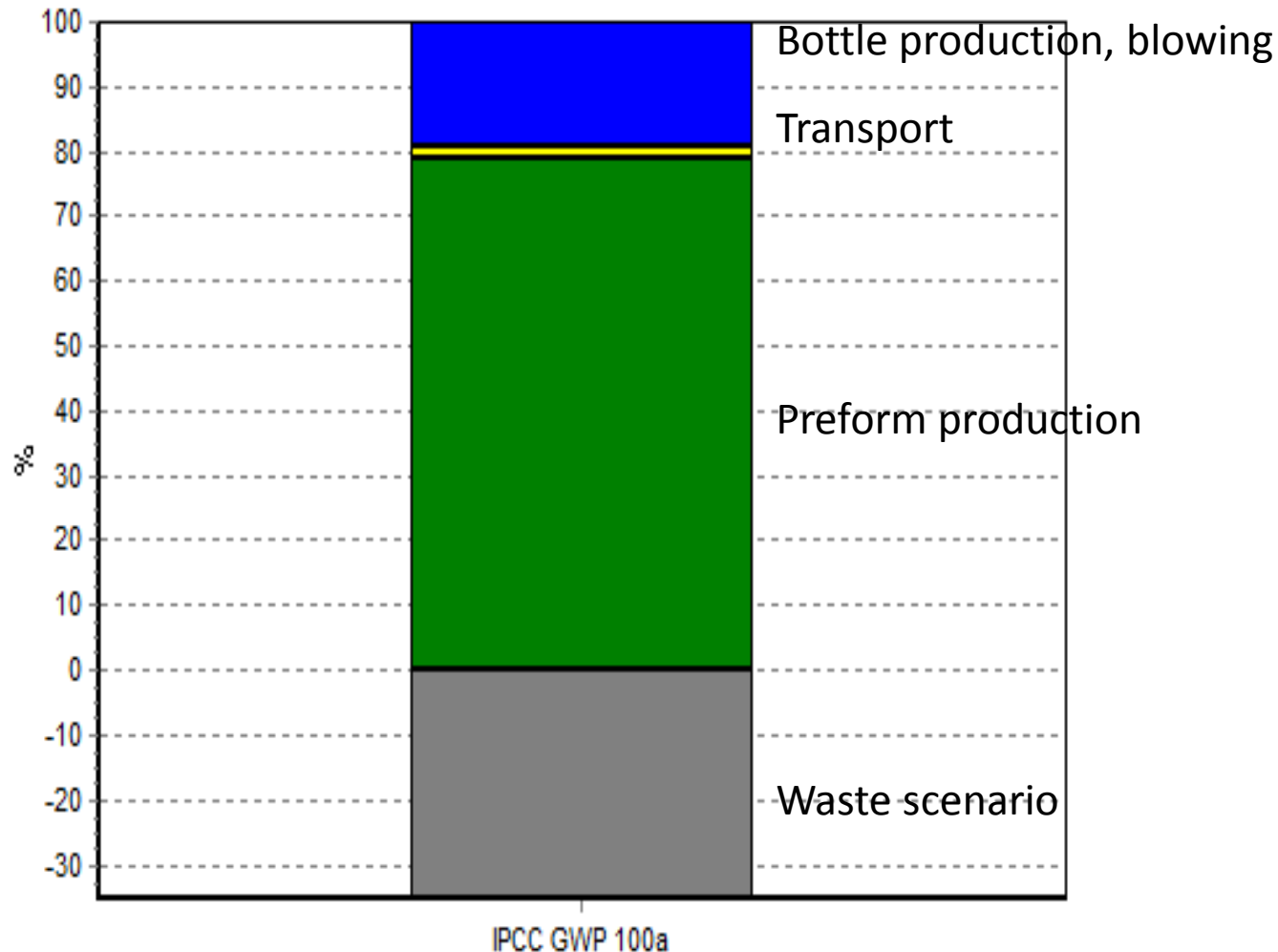
Comparison of different design of 1,5 L PET bottles

COMPARISON:

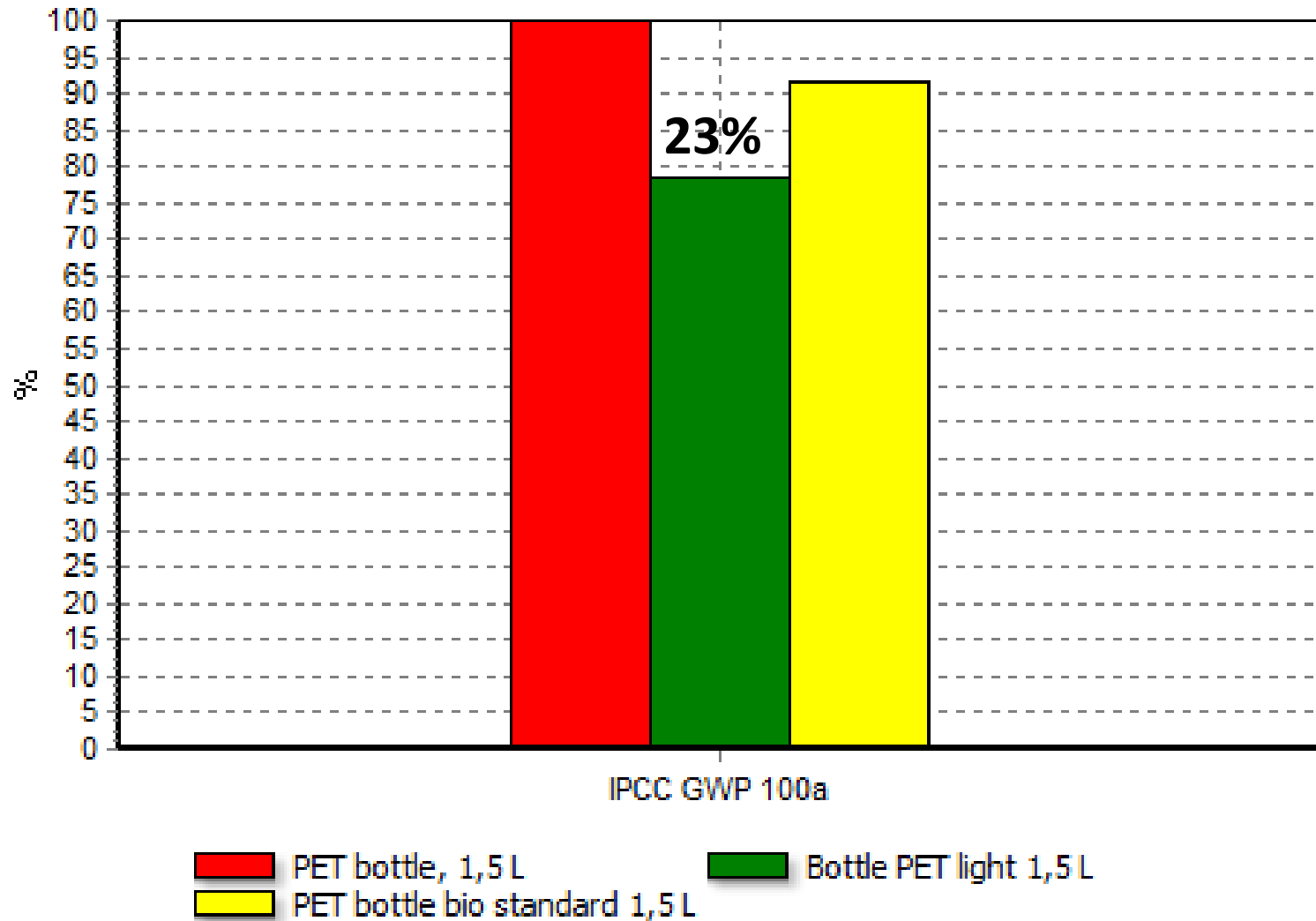
- Standard weight
- Light weight (24,5% lighter)
- Standard weight with 30 % bio plastic
- From primary material



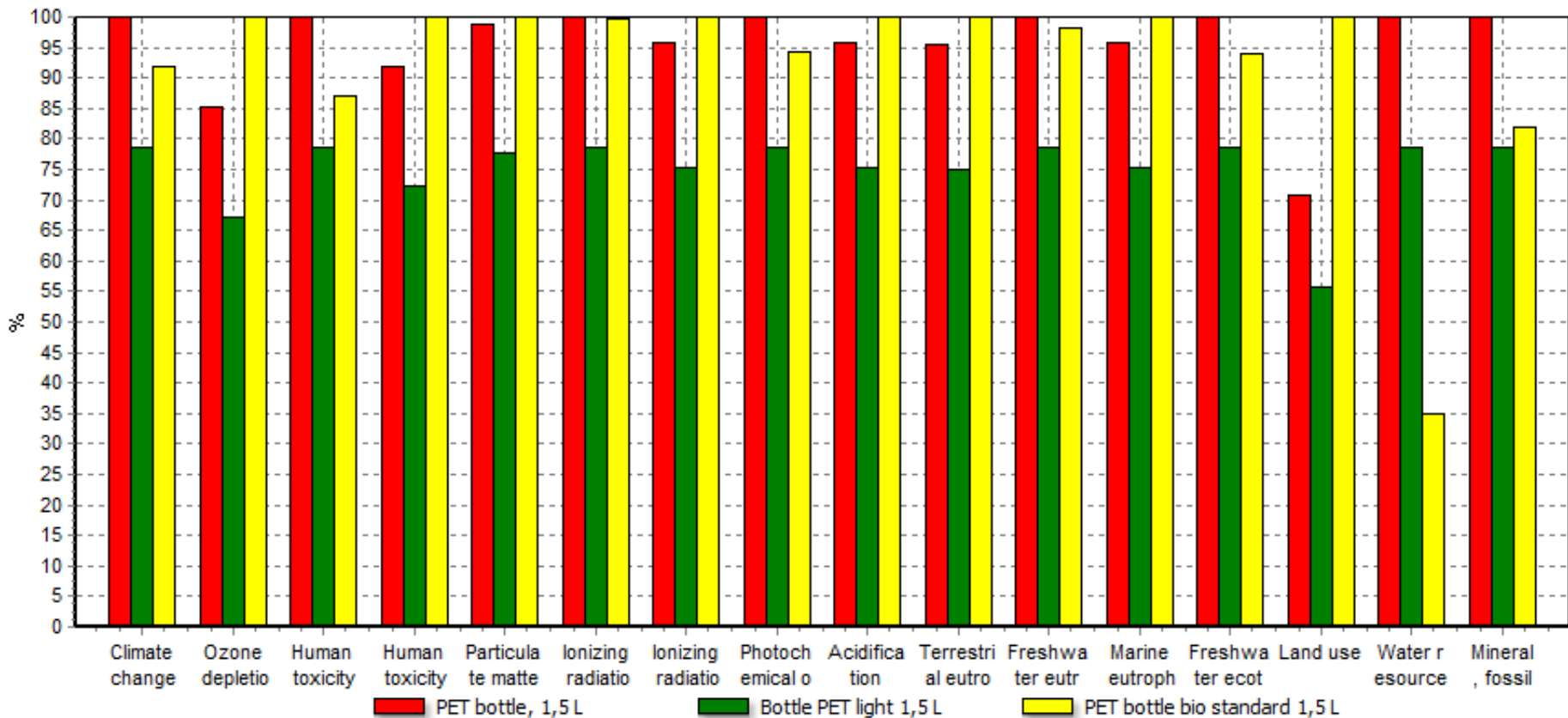
IPCC GWP 100a , during life cycle stages



IPCC GWP 100a Characterization



ILSD 2011 Midpoint+ , Characterization

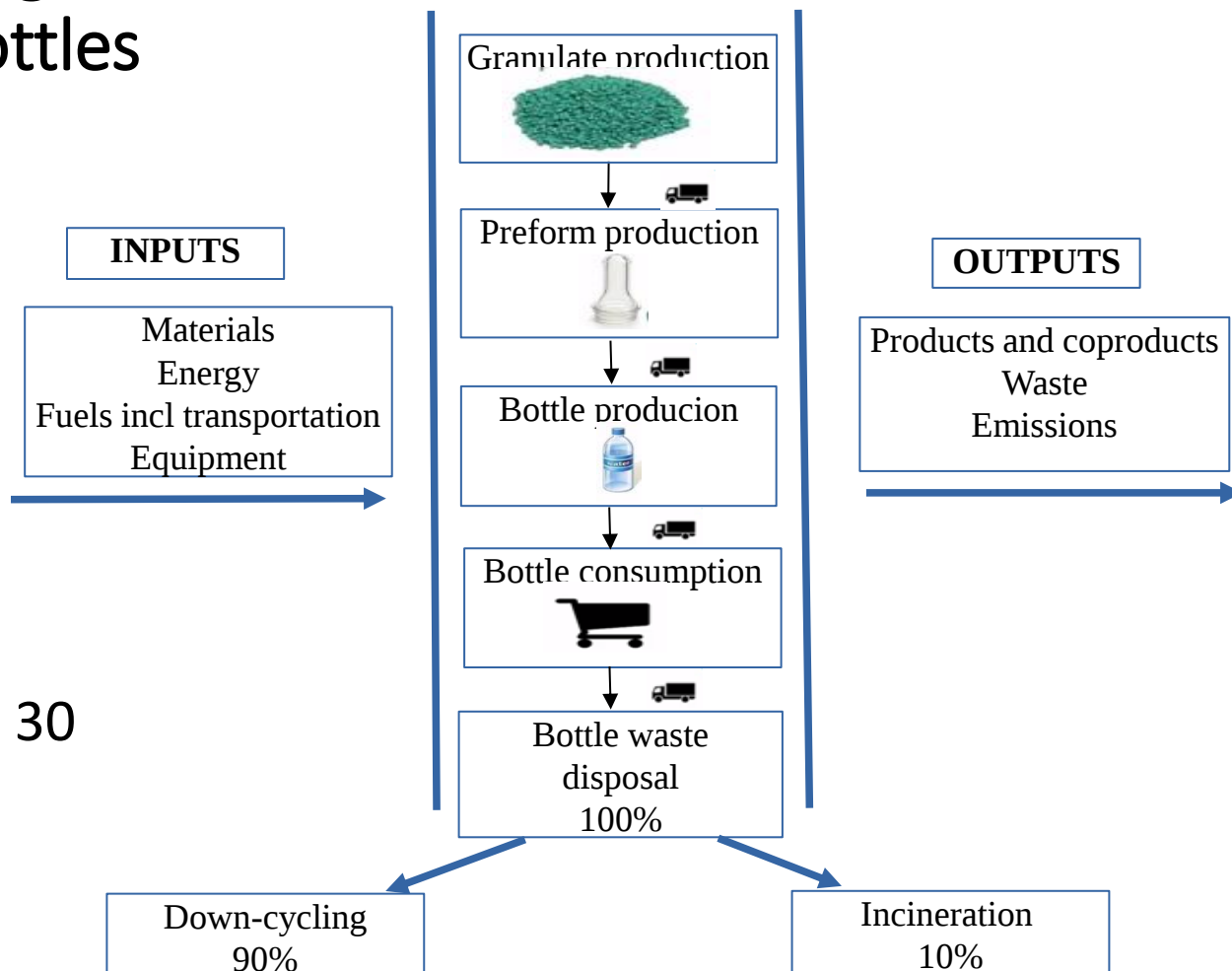




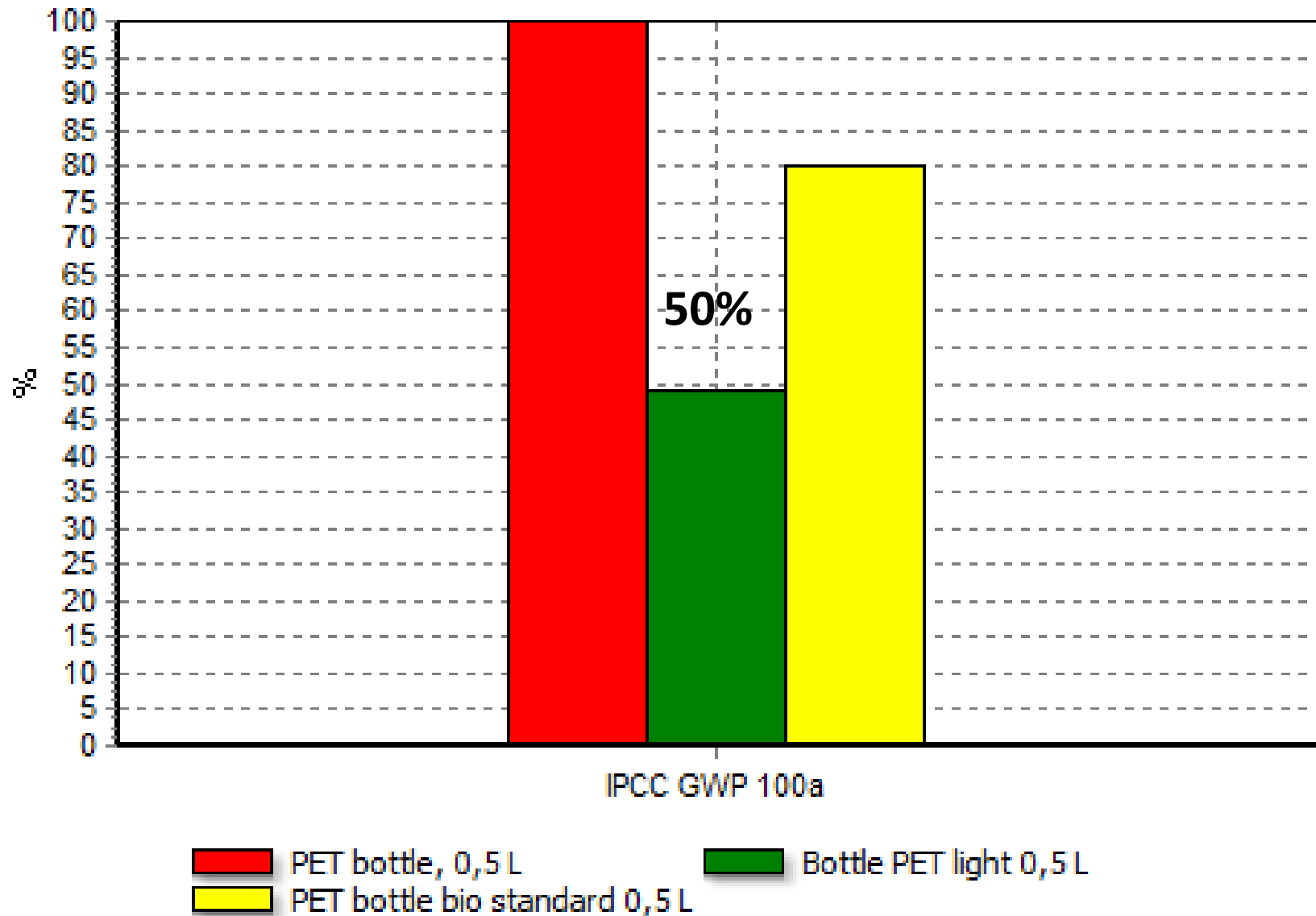
Comparison different design of 0,5 L PET bottles

COMPARISON:

- Standard weight
- Light weight (51% lighter)
- Standard weight with 30 % bio plastic



IPCC GWP 100a Characterization



Conclusions/Remarks

- Lietuvoje nėra rūpinimasi ir kalbama, kaip bus toliau panaudojamas deponito sistemoje surinktas PET, tik žinoma, kad bus parduodama aukcione, kuriame galės dalyvauti tiek Lietuvos tiek užsienio atliekų perdirbėjai
- Further situation - ?
- Not interested in Environmental topics/Interest Higher price for PET to cover costs
- Until now producers don't show any interest in including rPET
- No effort was made yet within Lithuania to establish closed-loop recycling
- Producers would need dedicate themselves to using rPET for bottle production first
- Economic , environmental reasons
- Lietuvoje techninių pajėgumų – įrenginių kur būtų galima perdirbti PET atliekas į aukštos (maistui tinkančios) kokybės antrinę žaliavą, šiuo metu veikiančių nėra. Yra Latvijoje.
- Cooperation Baltic countries for Closed Loop?
- 2 įmonės, kurios gamina PET ruošinius (preformas), gali pagaminti ruošinius, kuriuose būtų ir maistinės rPET. Žaliavą jie perka iš Latvijos ar kitų šalių, tačiau norinčių naudoti maistinį rPET butelių gamybai labai mažai, nebent specialūs užsakymai iš užsienio. Šiuo metu rPET 15 % brangesnis nei PET iš pirminės žaliavos.
- Teisėkūra, legislation, targets as in other countries.....politinė valia
- Cost benefit analysis still still need to do.

Conclusions/Remarks

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- Teisėkūra, legislation, targets as in other countries.....politinė valia

Apibendrinimai

- Aplinkosauginiu požiūriu, uždaro ciklo sistema yra naudingesnė, poveikis aplinkai mažesnis, tai parodė, tiek mūsų tyrimas, tiek ankstesni tyrimai.
- Lightweighting or closed loop, or both?
- Ekonominiu požiūriu - laisvos rinkos sąlygomis ir šiuo metu - rPET yra brangesnis. Bendros priežastys žinomos: žemos naftos kainos, pakankamai brangus surinkimo, perdirbimo procesas.
- Tačiau perdirbimo technologijos tobulėja, kalbama apie PET butelių gamybos, sudėties standartizavimą, kas palengvintų perdirbimo procesus.
- Reikalinga ir politinė valia, papildomos teisinės, ekonominės priemonės...kvotos
- Standartai perdirbtui plastikui, standartai dizainui, kas palengvintų perdirbimą.
- Galbūt galima būtų galvoti apie uždaro ciklo perdirbo sistemą Baltijos šalyse, nes vien Lietuvoje rinką pakankamai maža
- Viena, pažangi, mineralinį vandenį gaminanti įmonė apgailestavo, kad nėra jokio domėjimosi ir palaikymo iš valstybės pusės, nes jie būtų linkę gaminti butelius su rPET, bet šiuo metu jiems visiškai neapsimoka, nėra suinteresuotumo net rinkodariniais tikslais.



Final

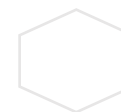


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Good start to
think in LT about
Bottle-to Bottle

Lightweighting
and
downcycling is
better option?

Thanks a
lot to
Swiss
partners



About rPET in Europe

Deposit
and
further
situation

Cooperation
with Baltic
states for
closed loop

in EU action plan for
Circular Economy

According EU

of the total plastic
volume

Recycling of exported in
Lithuania in 2014

There is high
fragmentation in all
value chain of plastic
industry

