

# Will increased recycling of plastic also increase the exposure to additives and hazardous chemicals under the circular economy?

## An inventory of chemical additives in plastic products in Norway



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### Background

- To confront plastic waste challenges, 50% of all plastic waste should be recycled in Norway by 2025, and 50% of all plastics put on market should be recyclable or made of recyclates. These targets are supposed to increase to 100% by 2050<sup>1</sup>.

### Challenge

- What are the fates of additive chemicals in recycled products?
- Are post-consumer plastics (PCP) safe to be reused for new applications?

### Methods

- The flows, stocks and sinks of seven plastic polymers (HDPE, LDPE, PS, PP, EPS, PVC and PET) in Norway were mapped using 40 applications in ten industrial sections (poster #8760).
- Chemical additives with production volume higher than 1000 t were selected from Wiesinger et al.<sup>2</sup> database.
- Those chemicals with missing information on industrial sectors and polymer types were excluded.
- Necessary information for 774 chemicals used in at least one of the seven polymers were available. Chemicals classified based on their applications and chemical functions.

### Approach

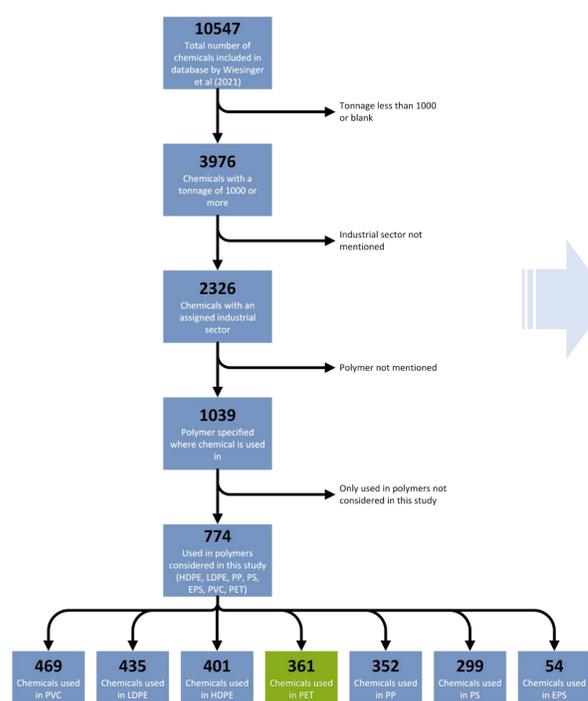


Figure 1: Selection process of the chemicals evaluated in this study

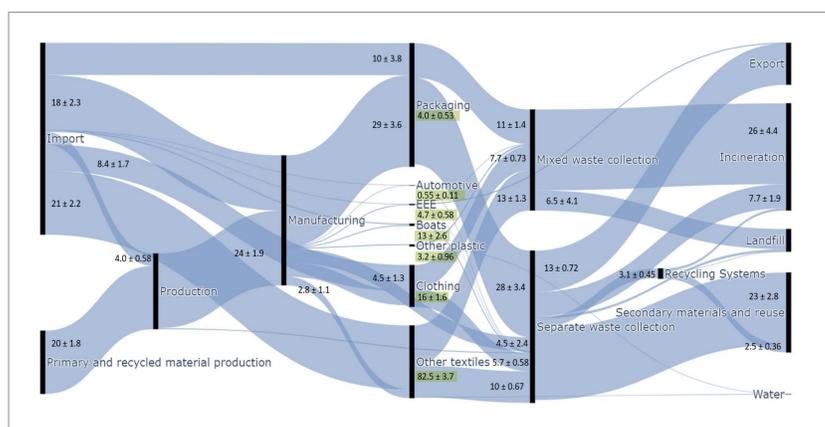


Figure 2: Material flow analysis of PET in Norway in 2020 from production to waste. Numbers are shown including standard deviation for flows > 1kt. Stocks of PET are shown in green.



Figure 3: Layers of chemical selection for further prioritization

### CASRN Most used plasticizers in PET

'100-21-0	1,4-Benzenedicarboxylic acid
'107-21-1	1,2-Ethanediol
'85-44-9	1,3-Isobenzofurandione
'104-76-7	1-Hexanol, 2-ethyl-
'106-98-9	1-Butene
'124-04-9	Hexanedioic acid
'57-55-6	1,2-Propanediol
'108-31-6	2,5-Furandione
'111-46-6	Ethanol, 2,2'-oxybis-
'115-77-5	1,3-Propanediol, 2,2-bis(hydroxymethyl)-
'126-30-7	1,3-Propanediol, 2,2-dimethyl-
'77-73-6	4,7-Methano-1H-indene, 3a,4,7,7a-tetrahydro
'8002-74-2	Hydrocarbon waxes
'110-63-4	1,4-Butanediol
'121-91-5	1,3-Benzenedicarboxylic acid
'123-86-4	Acetic acid, butyl ester
'504-63-2	1,3-Propanediol
'112-80-1	9-Octadecenoic acid (9Z)-
'9002-86-2	Ethene, chloro-, homopolymer
'106-46-7	Benzene, 1,4-dichloro-

### Results and discussions

- 361 chemicals were identified to be used in PET. Of these, 98 chemicals are named as plasticizers in PET packaging. Chemicals were ranked based on their potential amount used for each application.
- Further assessment of chemicals will be conducted on the basis of chemical functions, applications and toxicity.
- Targets for plastic recycling and use of recyclates should be set tactfully according to the chemicals in the waste material and the application of polymers in new products.

### References

<sup>1</sup>Klima- og miljødepartementet (2021). Noregs plaststrategi. Available at: <https://www.regjeringen.no/no/dokumenter/noregs-plaststrategi/id2867004/>

<sup>2</sup>Wiesinger, H., Wang, Z., & Hellweg, S. (2021). Deep Dive into Plastic Monomers, Additives, and Processing Aids. Environmental Science and Technology, 55(13), 9339–9351. <https://doi.org/10.1021/acs.est.1c00976>

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