Modelling recycling and waste incineration in life cycle assessment

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Boosting Circular Economy:
Circular economy advancements from Finland and around the World

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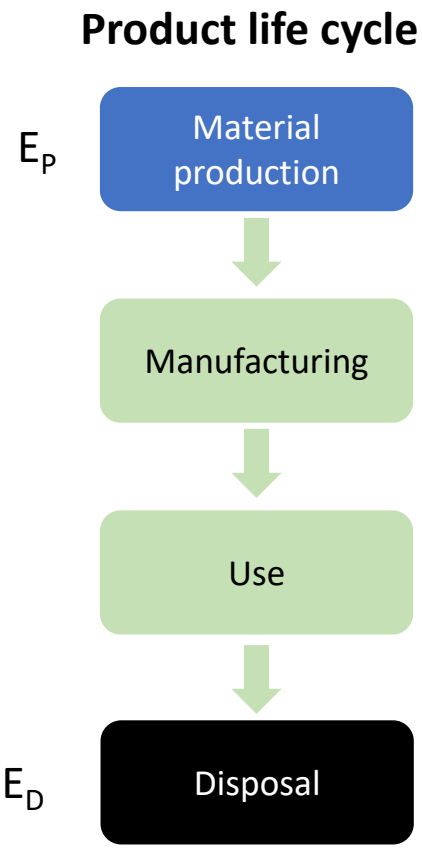
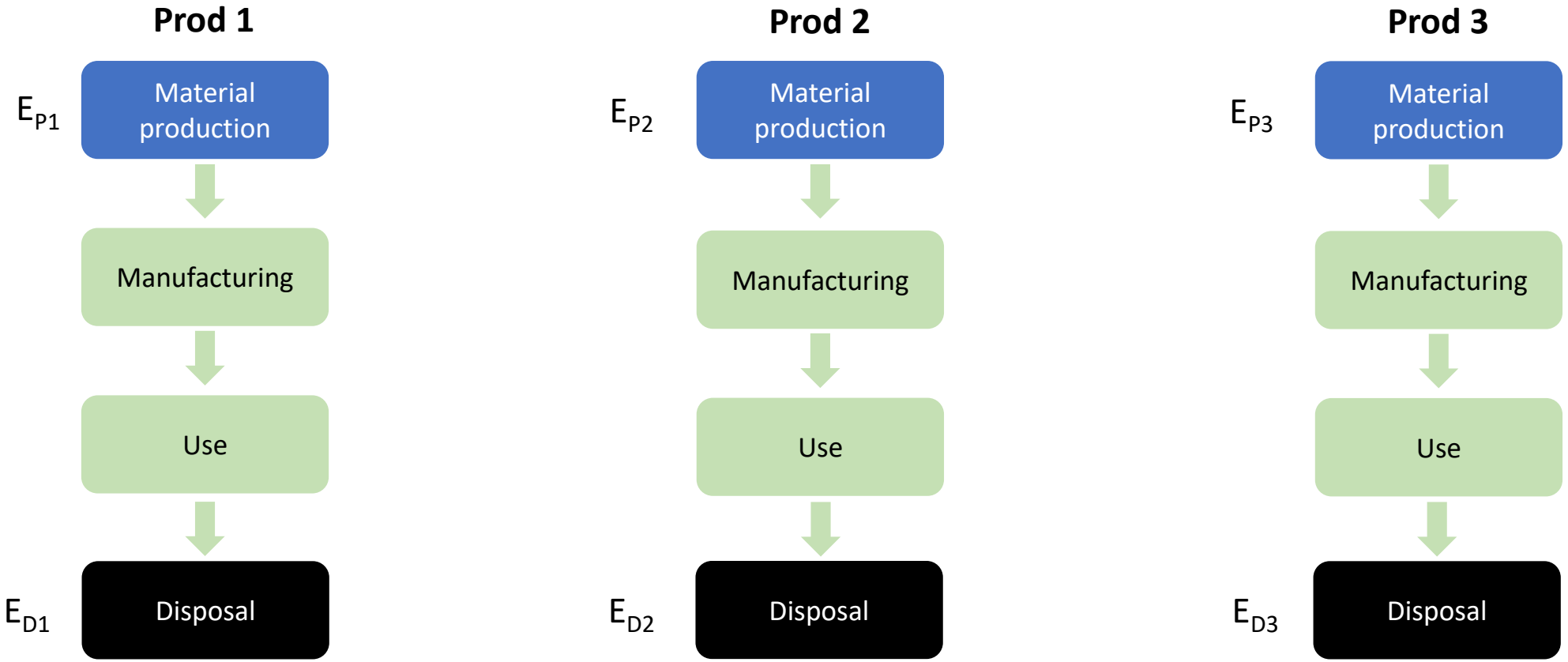
Life cycle assessment (LCA)



LCA assesses individual products



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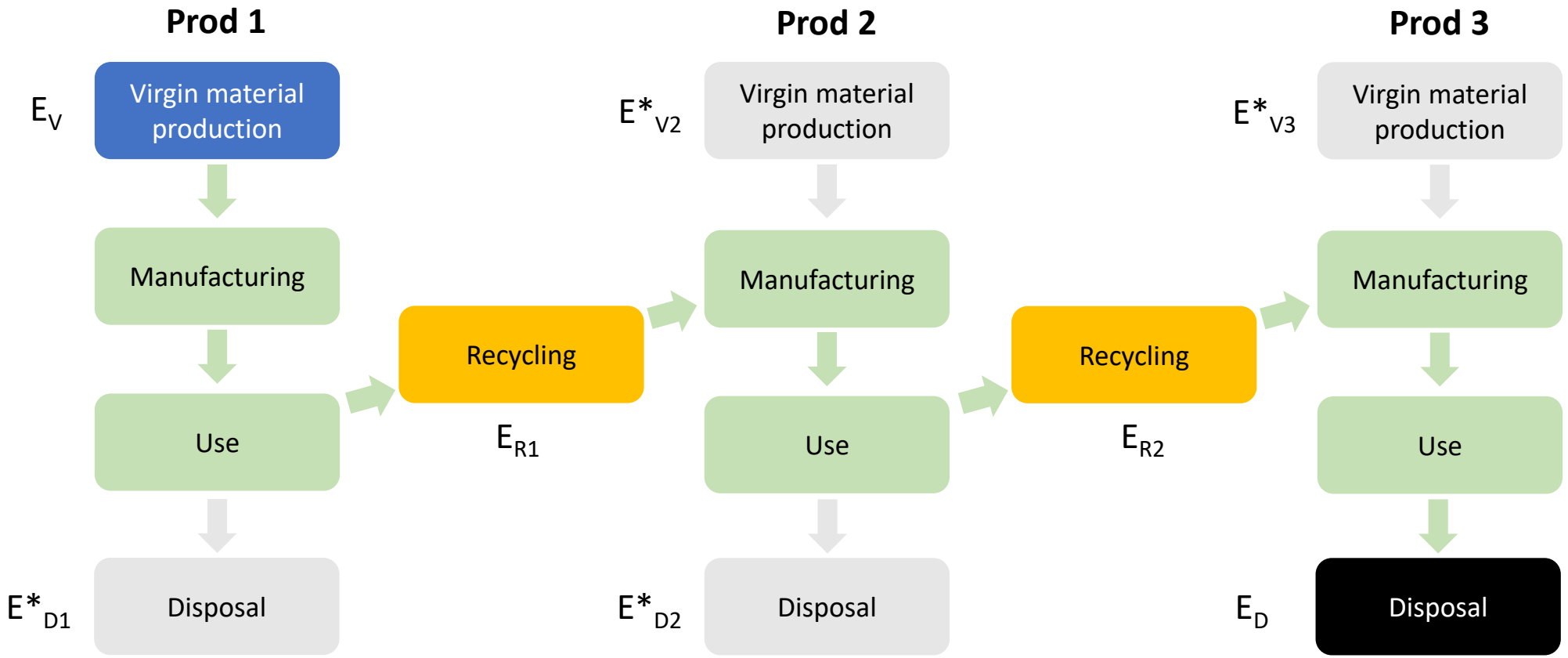
Products connected through recycling



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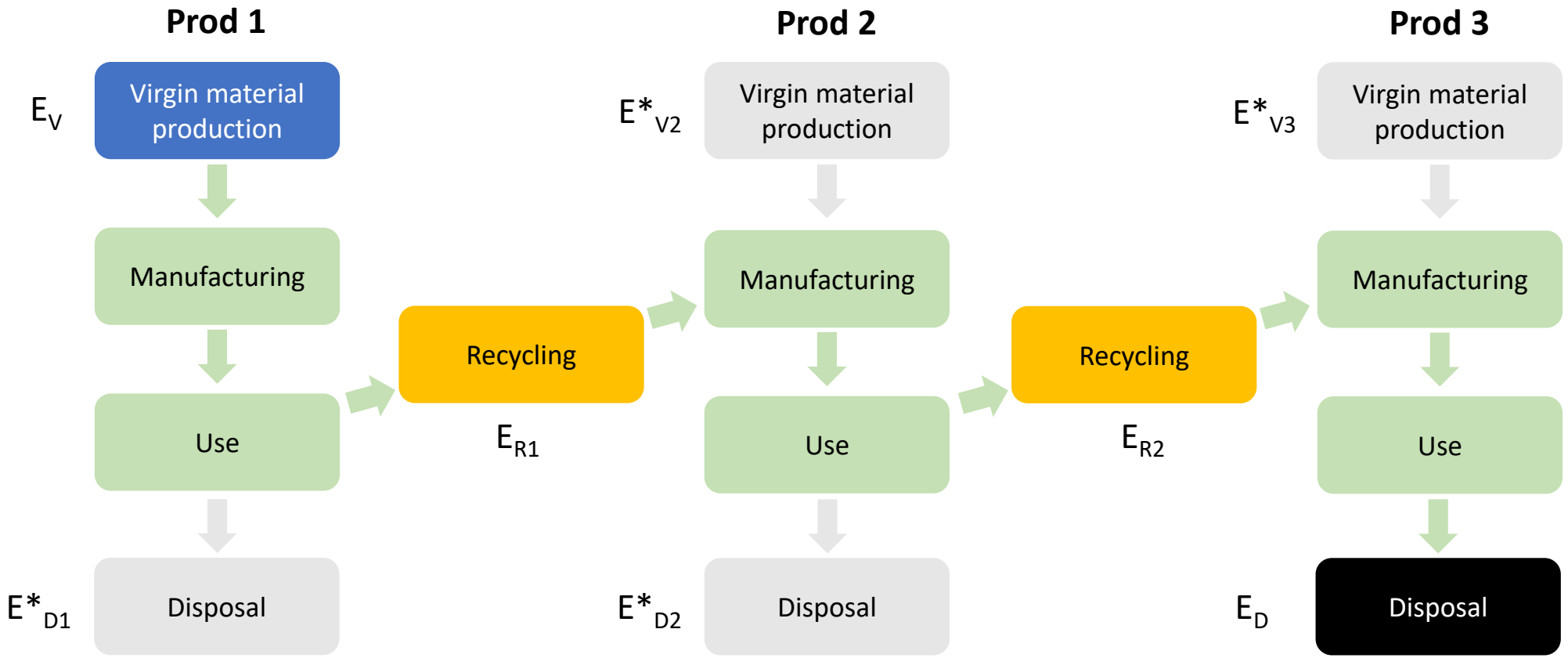
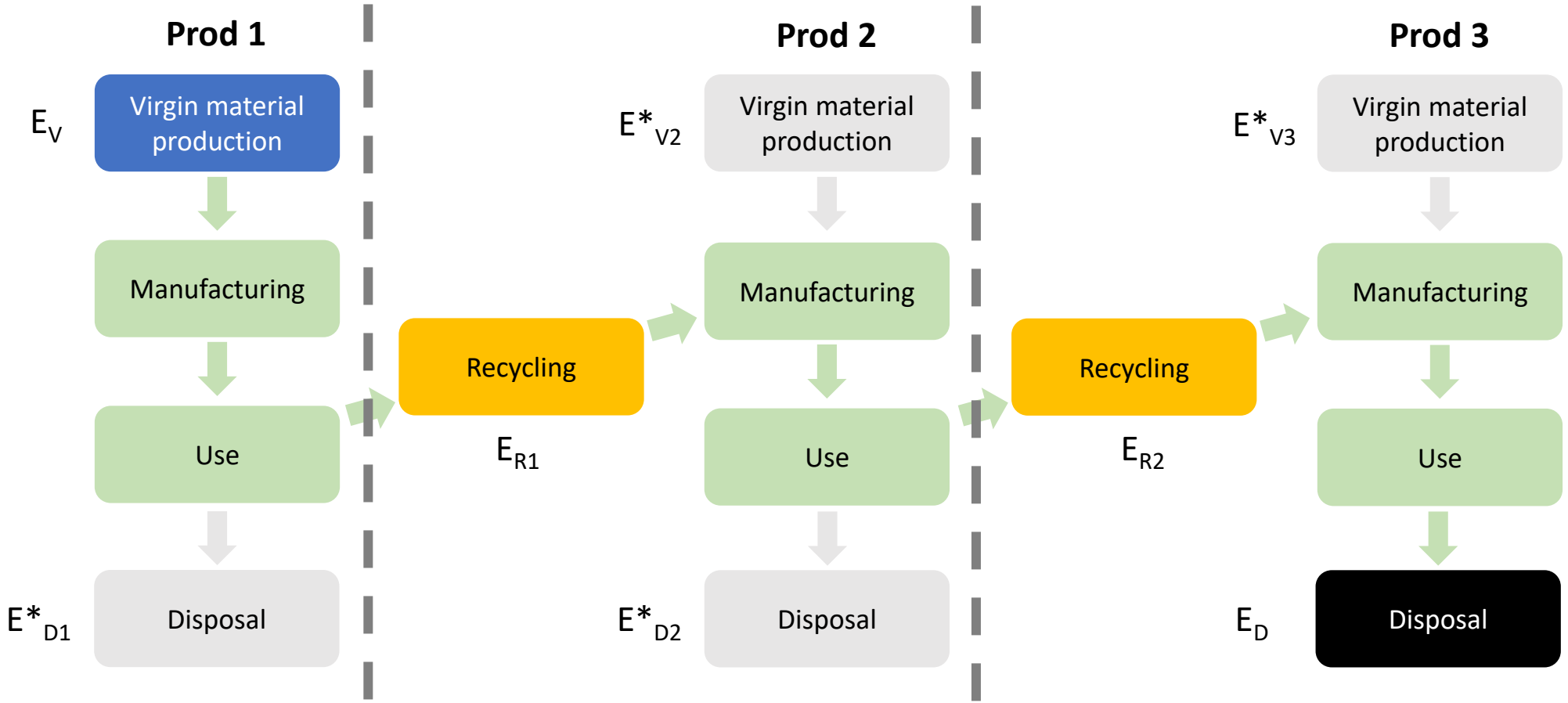
Products connected through recycling



Environmental benefit if $E_R - E^*_V - E^*_D < 0$

Cut-off (recycled content)



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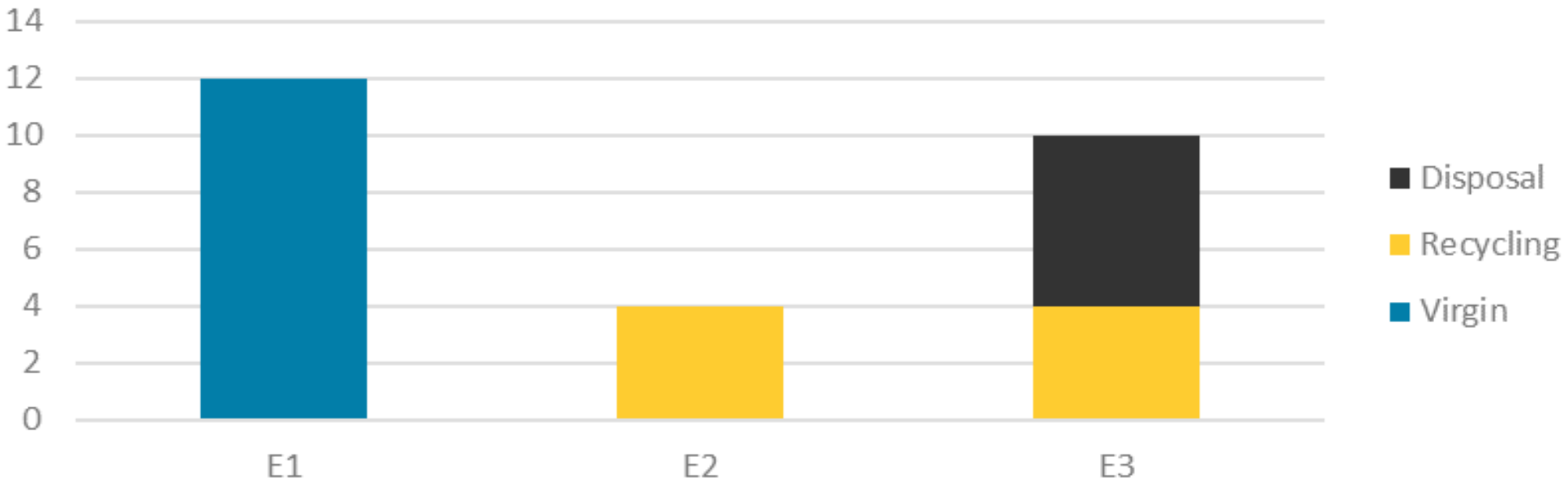
Cut-off results



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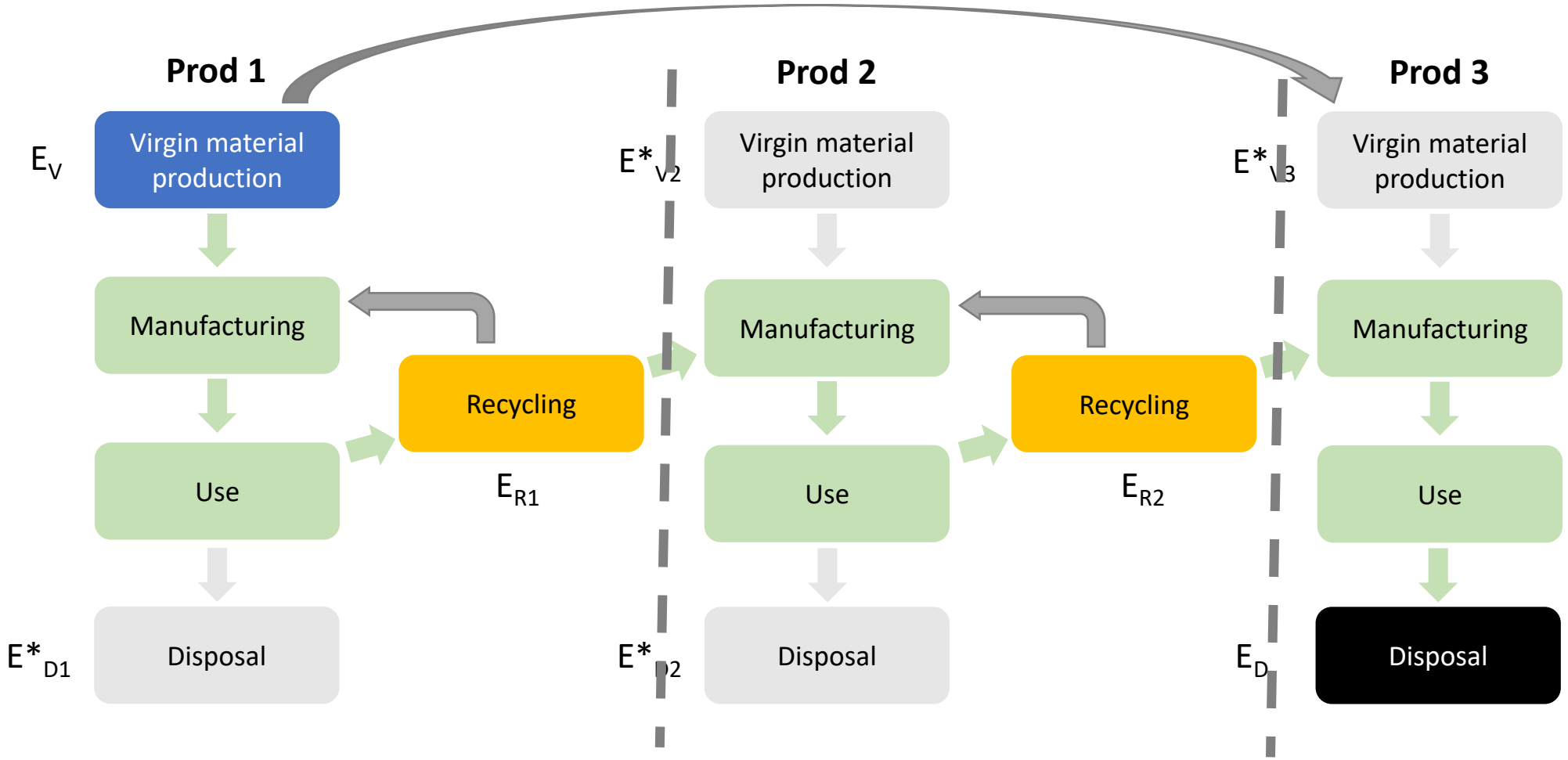
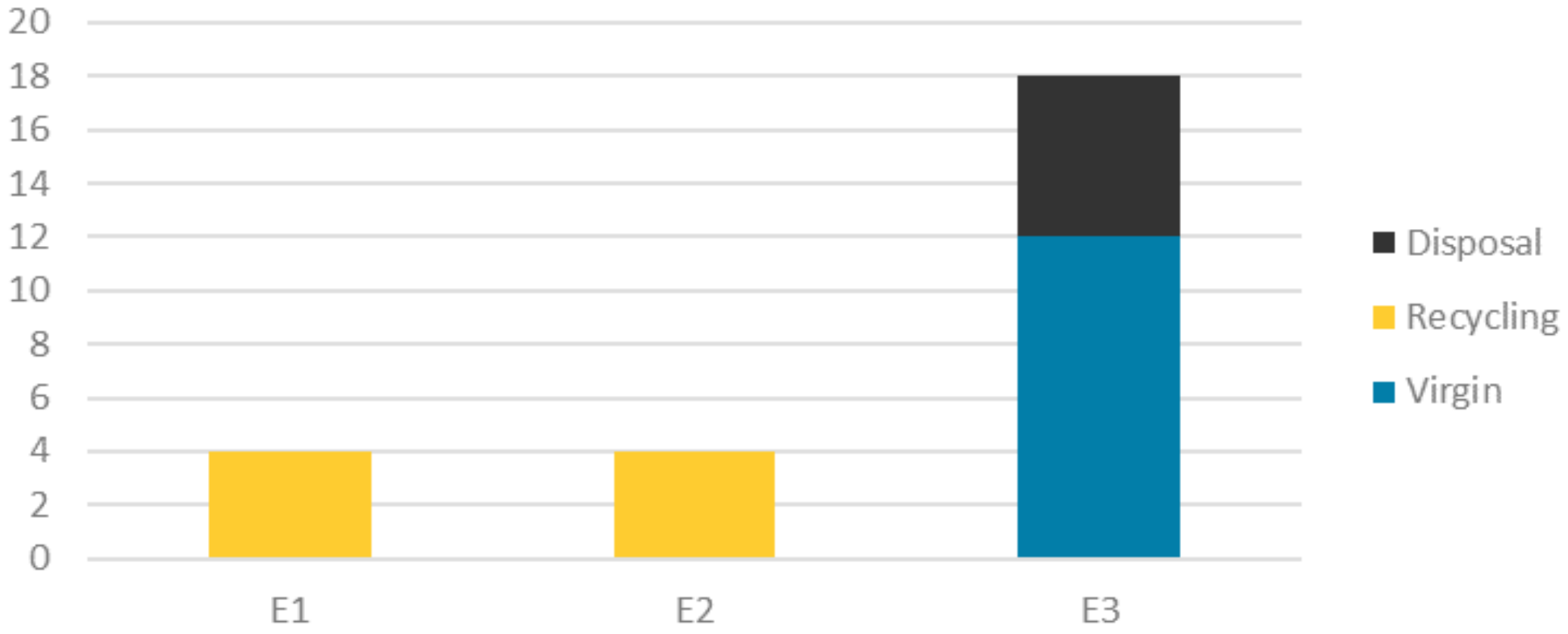
Closed loop (end-of-life) approach



End-of-life results



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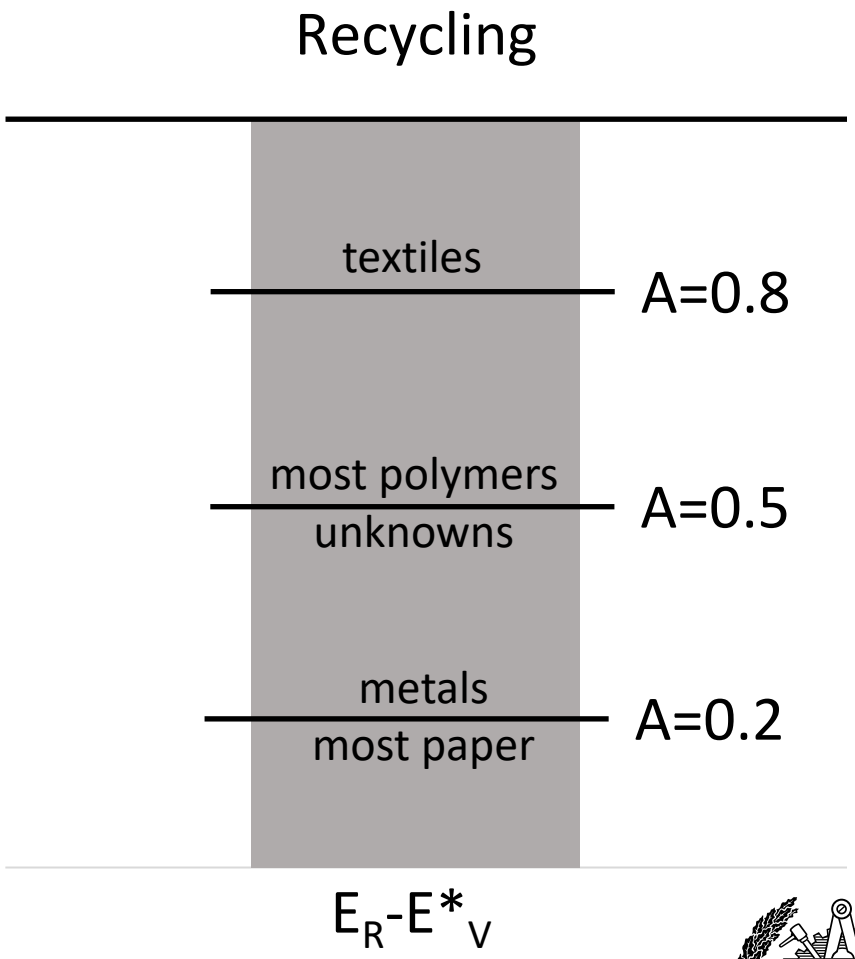
EU: Product Environmental Footprint Circular Footprint Formula

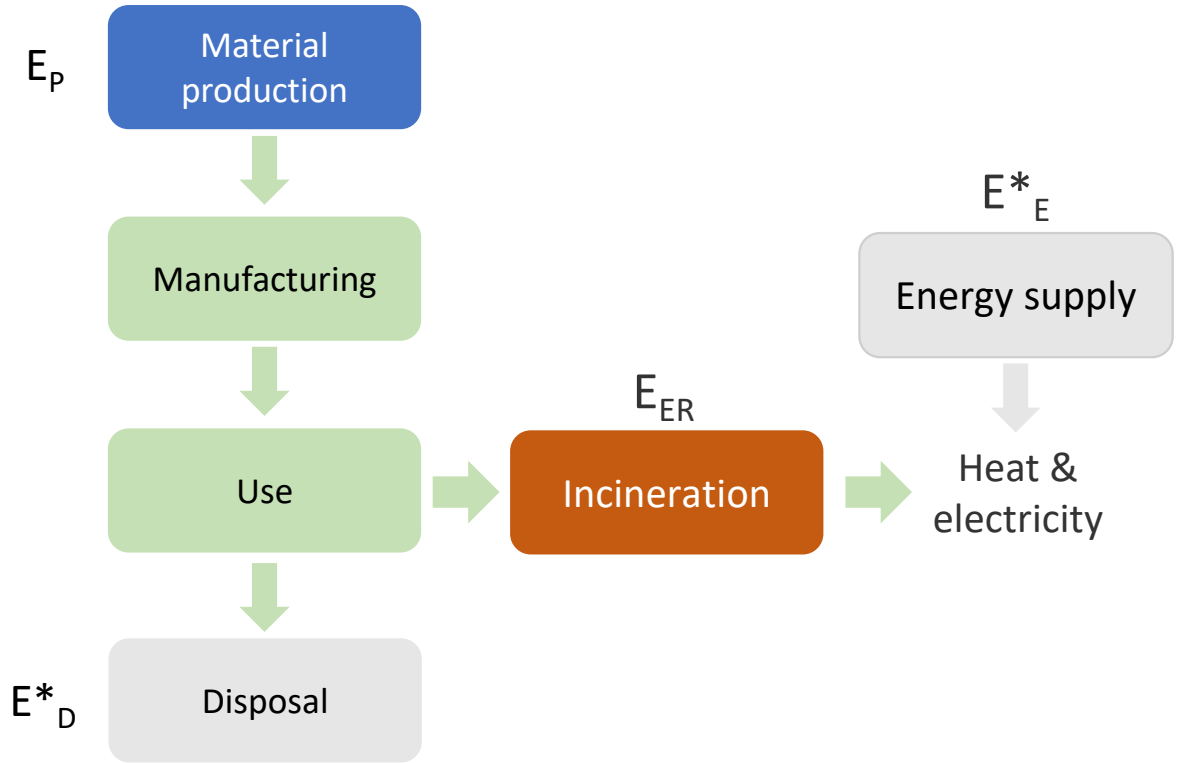
Allocates disposal (E_D) to last life cycle

Accounts for market conditions (Factor A)

Accounts for quality losses

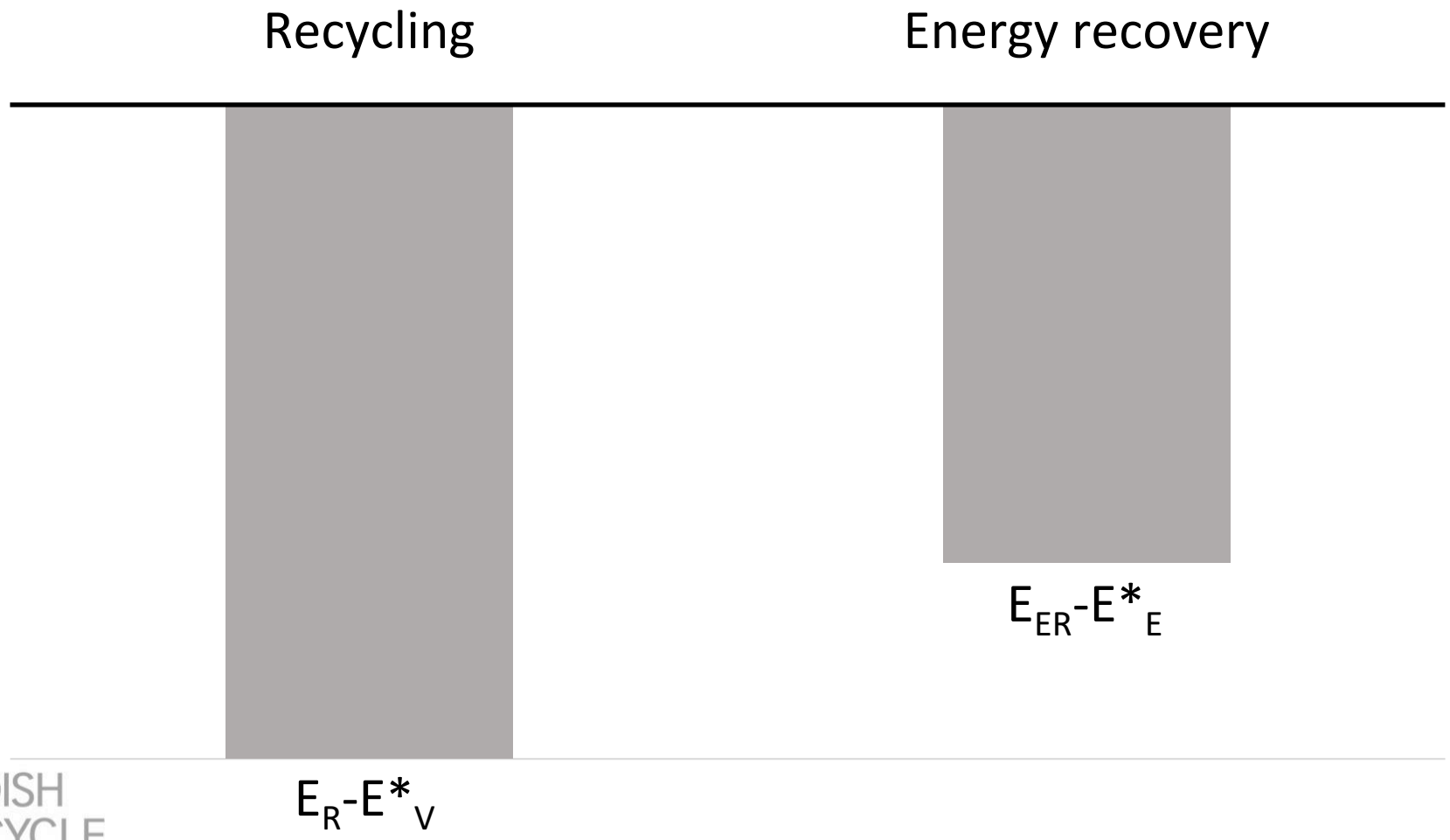


Modelling incineration with energy recovery

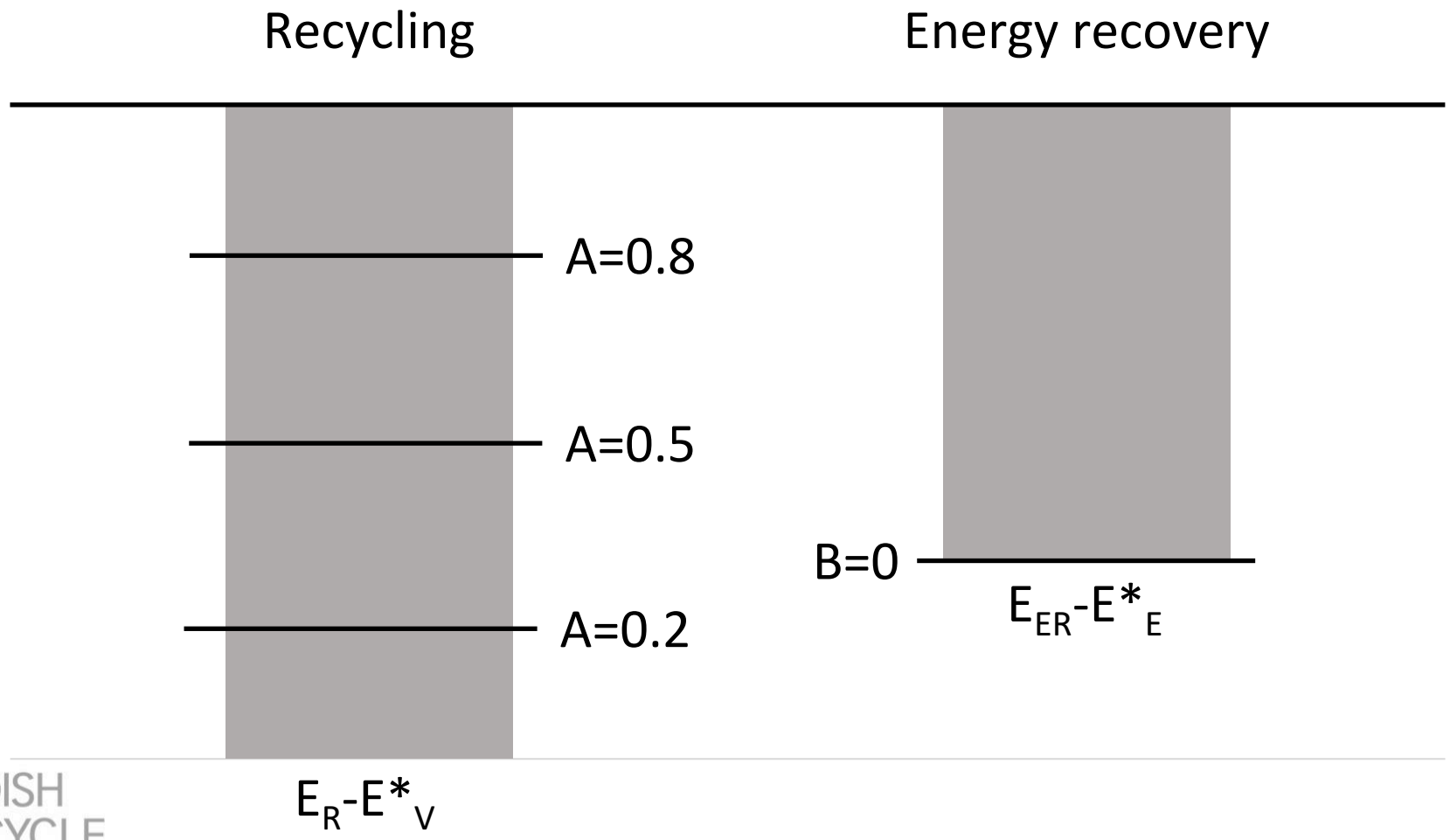


Environmental benefit if $E_{ER} - E^*_E - E^*_D < 0$

Comparing recycling and energy recovery



PEF comparing recycling and energy recovery



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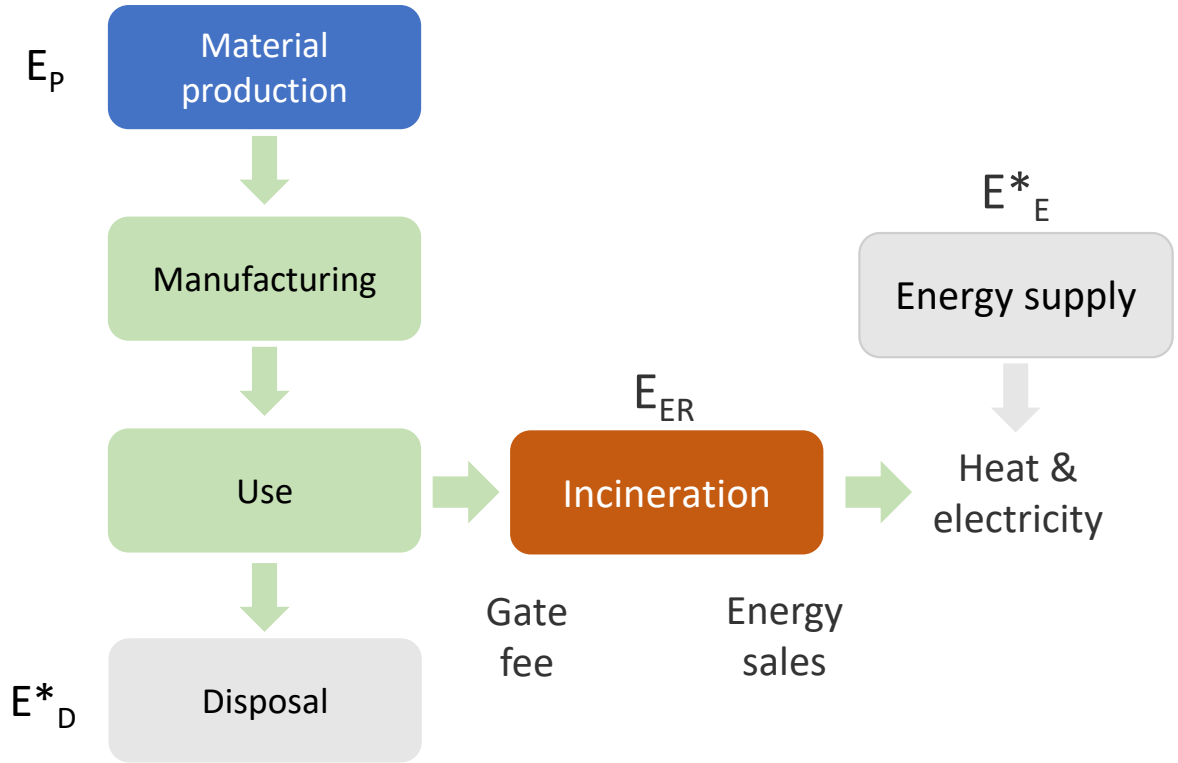
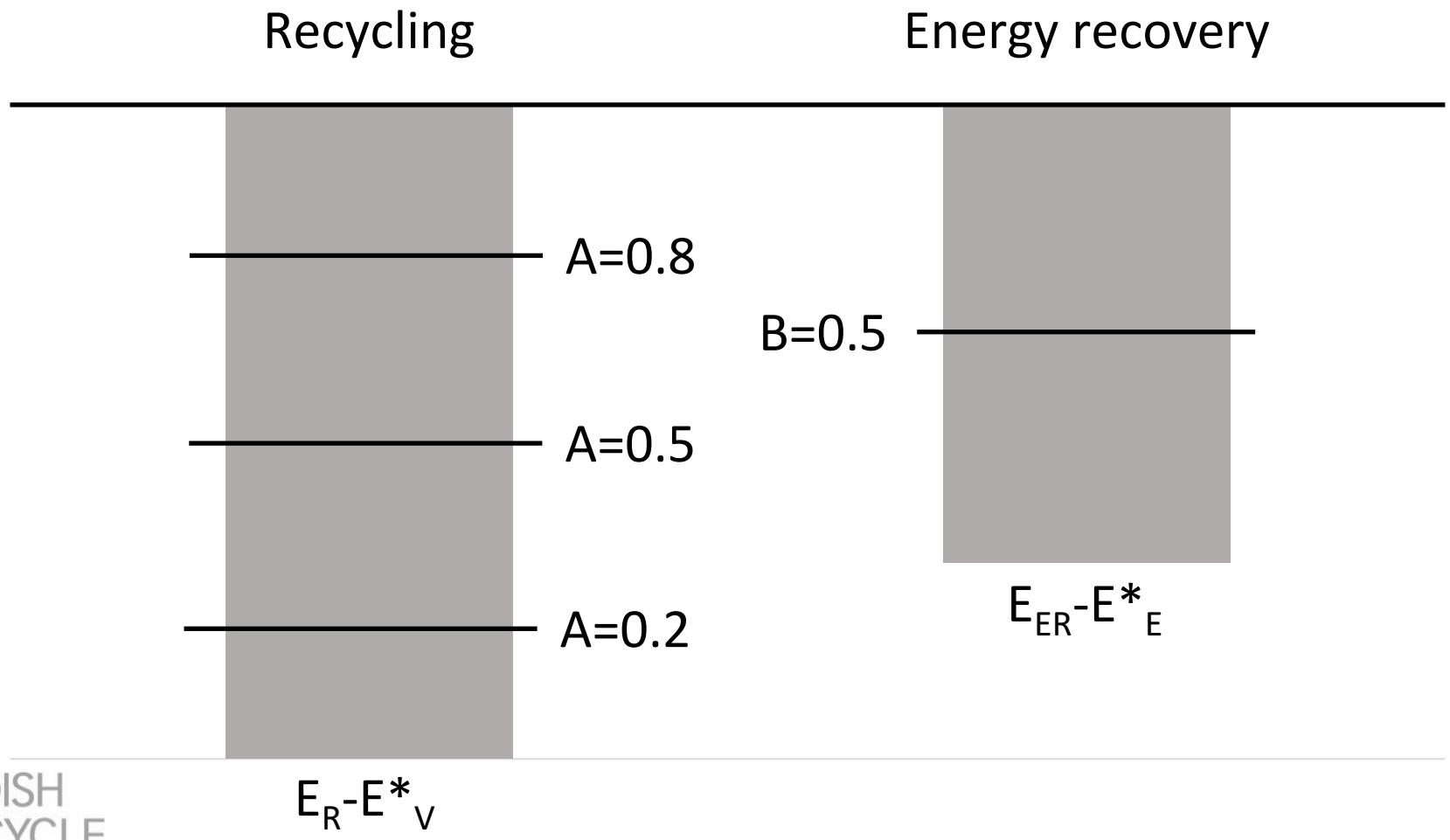
Economic feasibility of incineration investments



Proposal:
Calculate B based on gate fee and energy revenues



Thanks for the attention!

References

Ekvall T, Björklund A, Albertsson GS, Jelse K (2020) Modeling recycling in life cycle assessment. IVL Svenska Miljöinstitutet, Stockholm.

Ekvall T, Gottfridsson M, Nilsson J, Nellström M, Rydberg M, Rydberg T. (2021) Incentives for recycling and incineration in LCA: Polymers in Product Environmental Footprints. Report 2021:02. Swedish Life Cycle Center, Gothenburg, Sweden.

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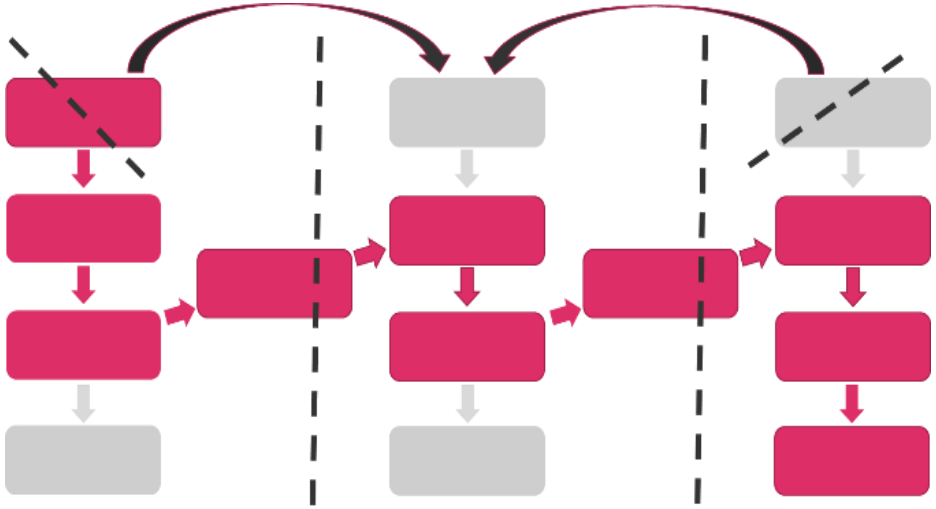
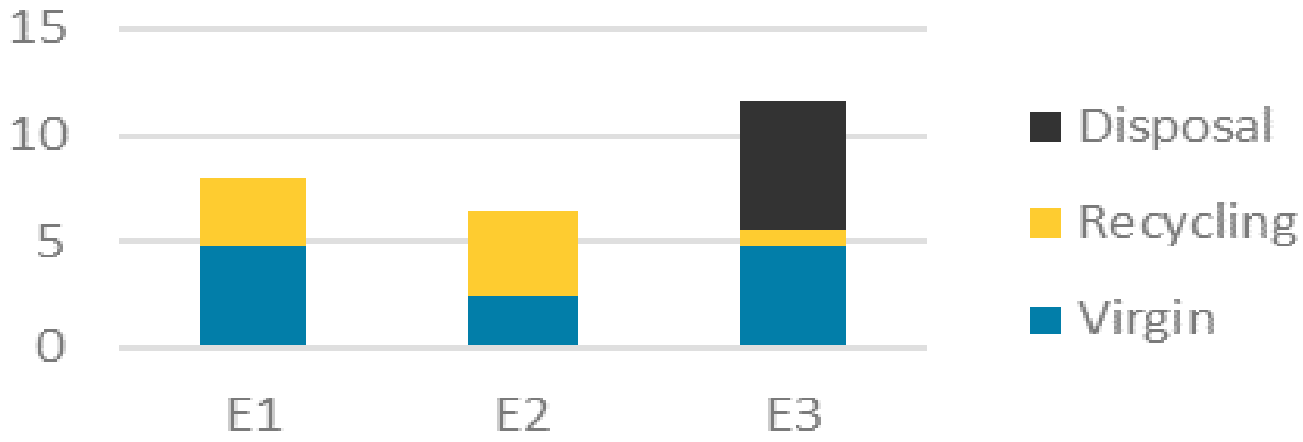
Circular Footprint Formula



$$E = (1-R_1)\times E_V + R_1\times[AE_{Rin} + (1-A)E_V \times Q_{Sin}/Q_P] + + (1-A)R_2\times[(E_{Rout} - E^*_V \times (Q_{Sout}/Q_P)] + + (1-R_2)\times E_D$$



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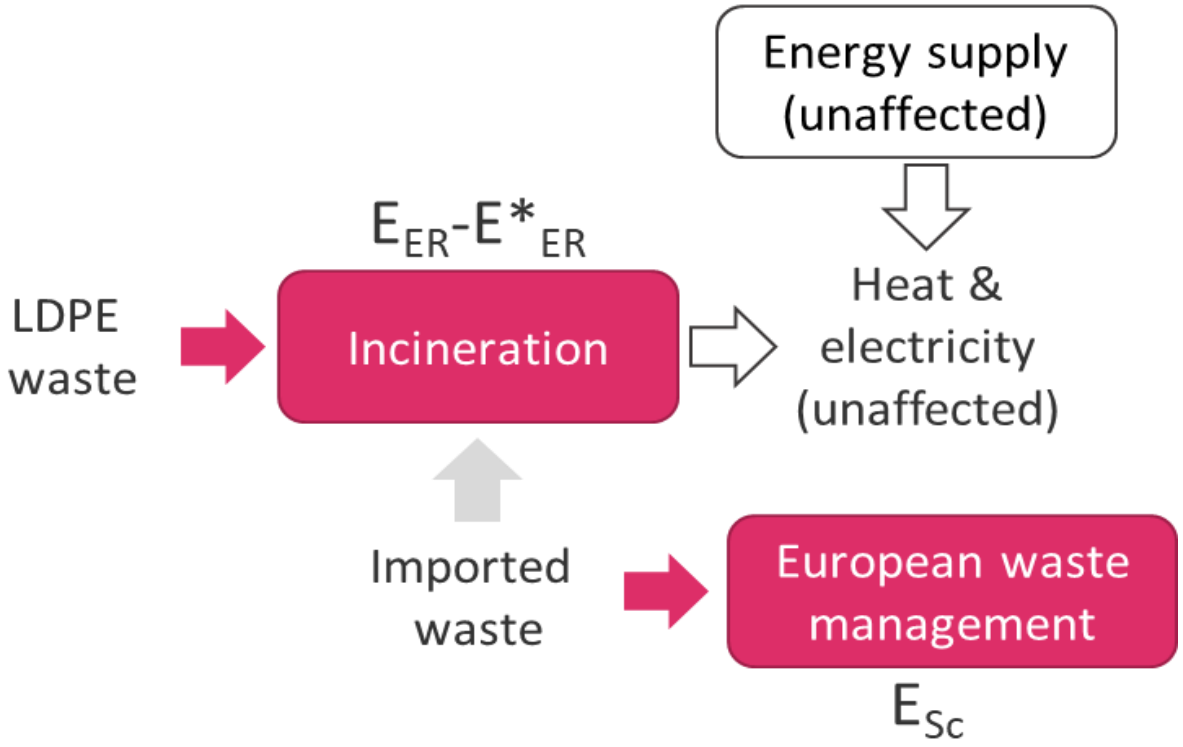
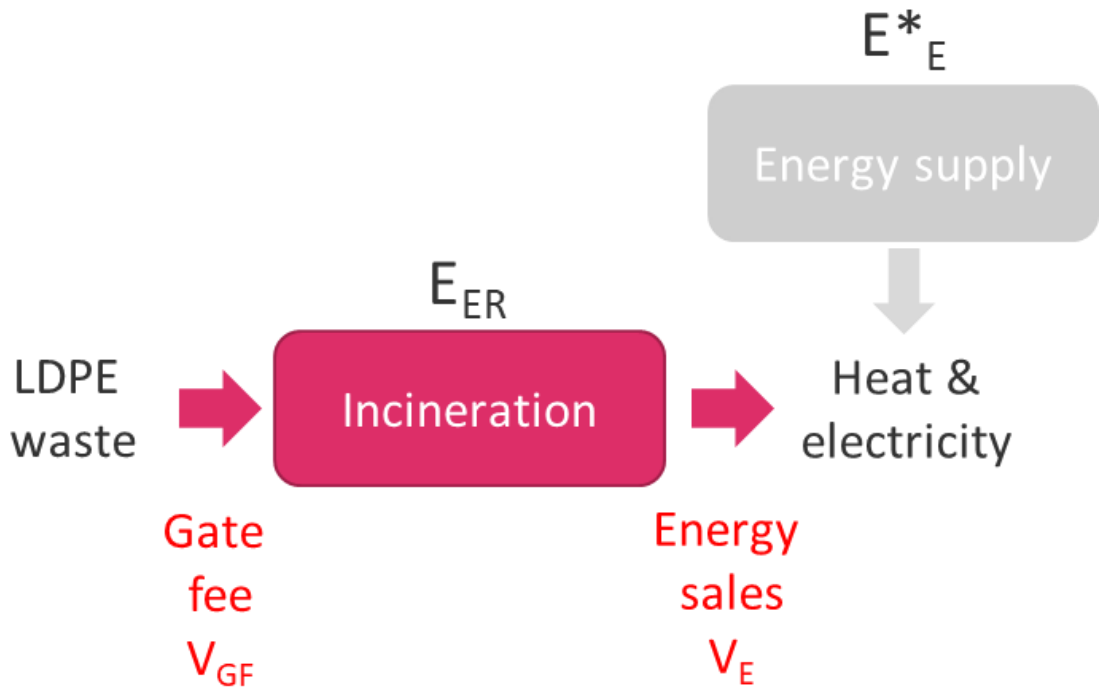
Short-term: LDPE replaces other waste



Two scenarios:

- European landfill
  with landfill gas extraction
- European incineration
  with electricity production

Long-term: drivers of investments



- Proposed approach: $B=V_E/(V_{GF}+V_E)$
- Tentative for Sweden: B=0.6