Plastics Waste and Circular Economy. Low-Density PolyEthylene recycling feasibility study.

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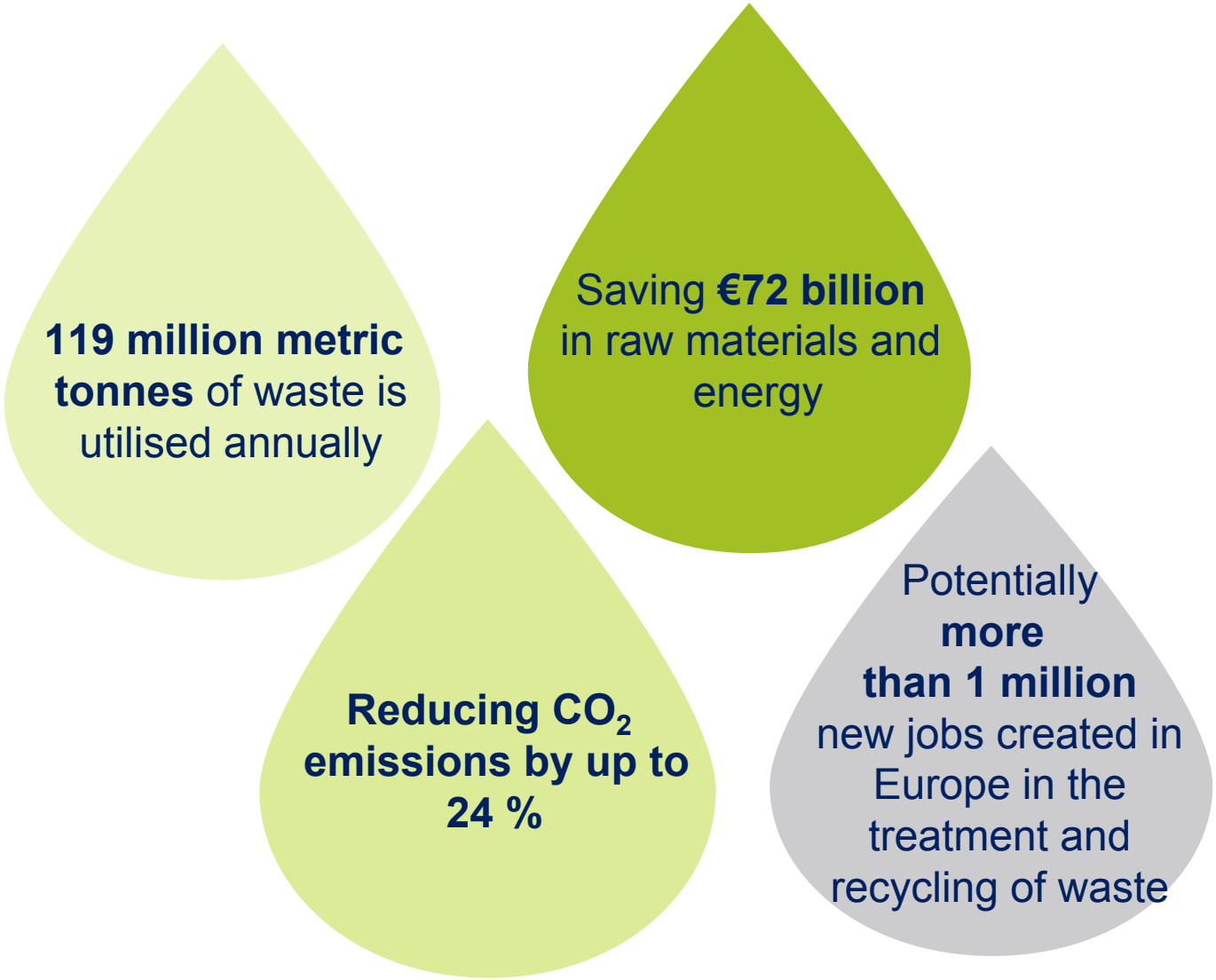
Introduction

Waste must be utilised if the EU wishes to maintain its industry and competitiveness

- 150 % increase in prices of raw materials between 2002 and 2010
- By 2020, 82 billion metric tonnes of raw materials shall enter the EU economic system (+ 24 % compared to 2010)
- 15 metric tonnes of raw materials is accounted for one citizen in the Czech Republic
- **26.3 % of plastic waste is recycled within the EU**
- **€8.3 billion of plastic waste ends up in landfills within the EU countries without any benefit**
- 42 million metric tonnes of electrical and electronic waste is generated in the world; 6.5 million metric tonnes is recycled

Circular economy in practice

Benefits of introducing circular economy to the EU countries in 2020



Landfilling forever??

- High dependency on waste disposal without **actual** utilisation within the EU (60 % to 70 %)

Introduction

Key pillars for a circular economy :

- **Financing** from the Horizon 2020 program by over **€650 million** and from the Structural Funds to the tune of **€5.5 billion**
- Measures to reduce **food waste** by **half** by 2030 (currently up to 1/3 of all produced food)
- Preparing **quality standards** for secondary raw materials and support for **Ecodesign**
- Review of the Regulation on **fertilisers** (70 % of phosphorus in wastewater is not recycled)
- Measures for **water reuse**
- Strategy relating to **plastics** in the circular economy; reducing waste **in sea**

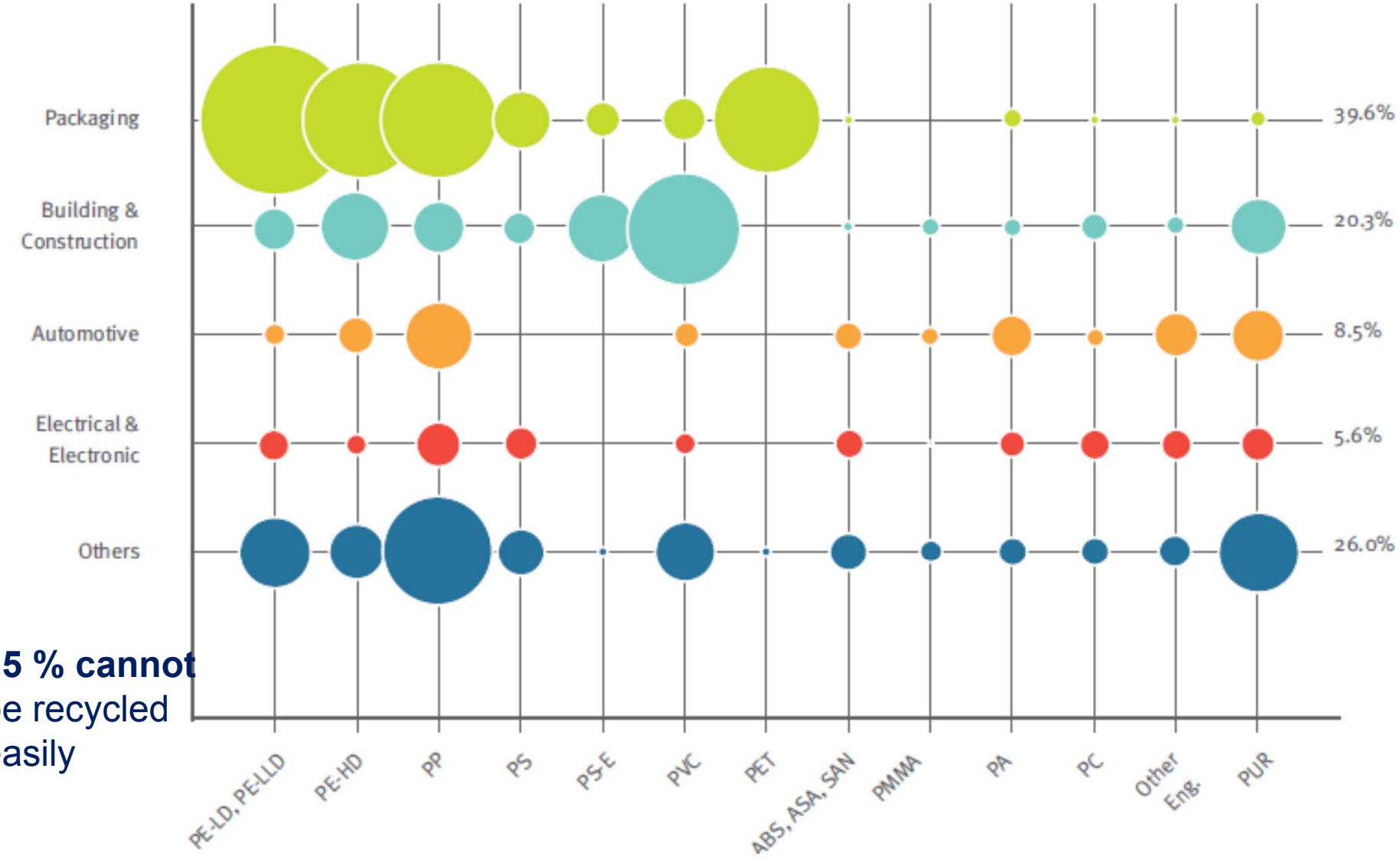
What's to be done by 2030?

- **Increasing recycling up to 75 %** of all packaging waste and other utilisable waste
- Sharp increase in the reuse and **recycling of municipal waste to over 65 %**
- **Ban on landfilling of recyclable materials,** increasing taxes on landfill and ban on technical security of landfills, ban on the dumping of waste on the land surface
- Reducing the total amount of waste going to **landfills to 10 %**
- Promoting economic tools to discourage **landfilling** (EU fee of €60; ČR €18)
- Measures to encourage the **reuse** and stimulating industrial **symbiosis** (transformation of a by-product from one industry into raw materials for another industry)

What's to be done by 2030?

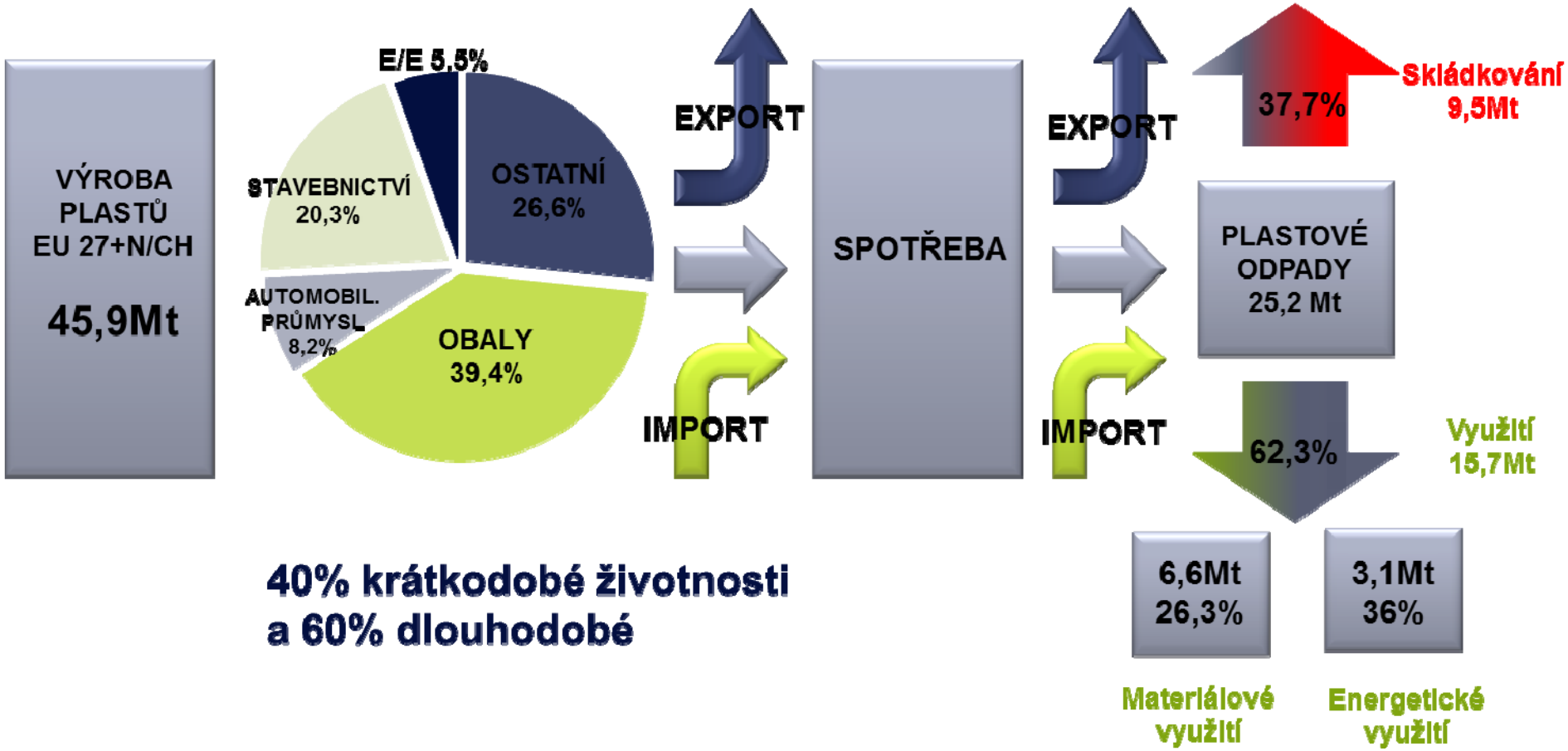
- **Targeted support** for education, research and development in new technologies
- Further **support to develop market** with raw materials from the recycling industry
- Incentives for manufacturers to offer **greener products**
- Using the **EU funds** primarily for waste infrastructure projects
- Support for **targeted retraining** to accommodate new needs in industry and agriculture

Consumption of plastics in different industries

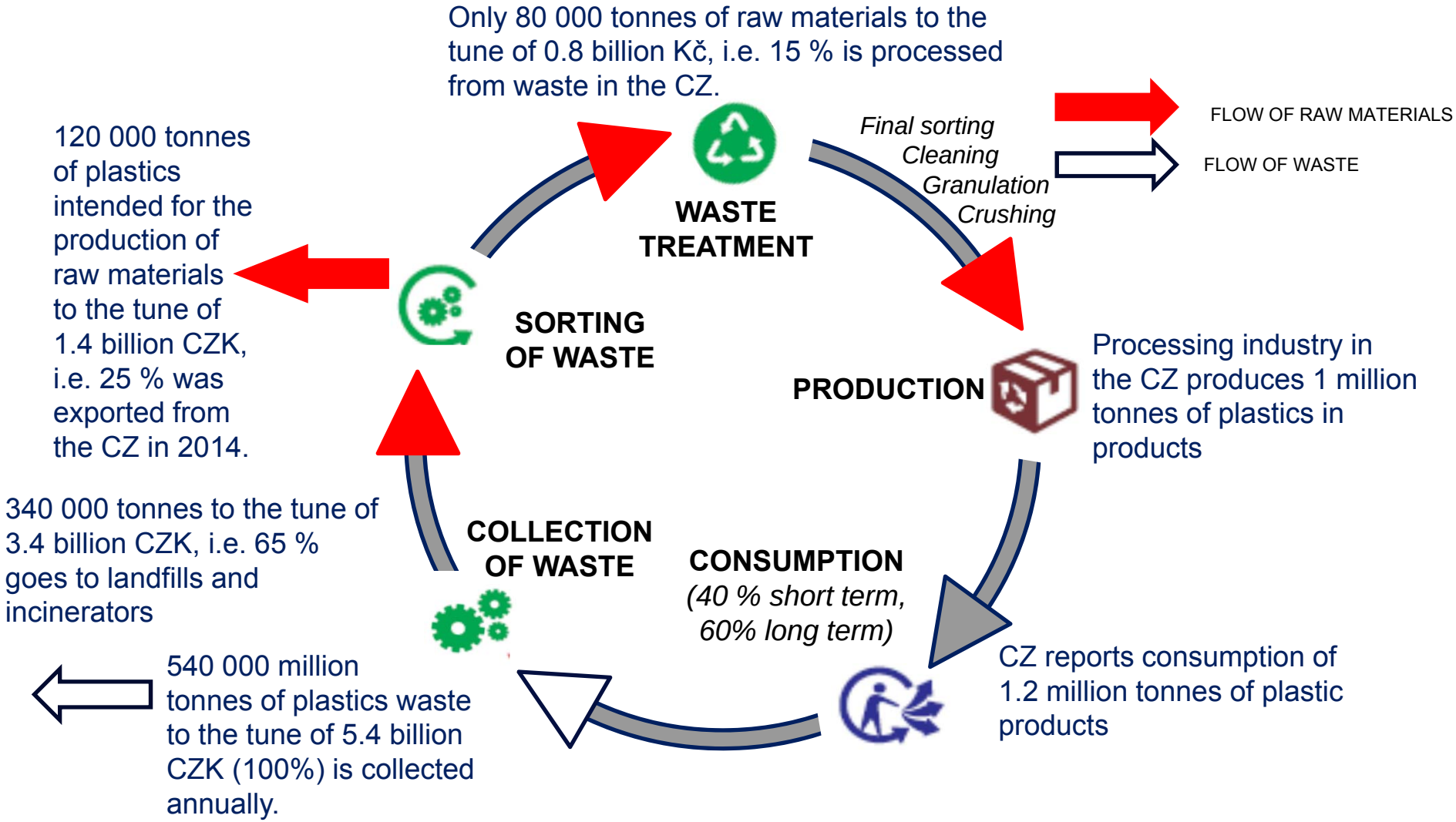


25 % cannot be recycled easily

Management of plastic waste in the EU



Plastics in circular economy in the Czech Republic (CZ)



Circular economy for polyethylene (PE)

- The most common group of plastic waste (4.4 million tonnes; €90 million worth of raw materials; 35 000 new jobs).

- Universal awareness of this type of plastic among experts, general public and also among direct users.

- **Significant incidence of this type of waste in landfills** where due to the inappropriate storage and compacting it forms continuous layers, i.e. artificial seal, which inhibits penetration of landfill water to the lower layers whereby the water uncontrollably leaks from landfill mass.

Circular economy for polyethylene (PE)

- Mechanical/biological treatment of mixed waste has limited number of options; such waste must be carefully sorted out thus causing considerable difficulties in the early stages of sorting (blockages, entanglement).

- **Products made from recycled LDPE waste may be very aptly used for the collection of waste in the form of plastic bags.**

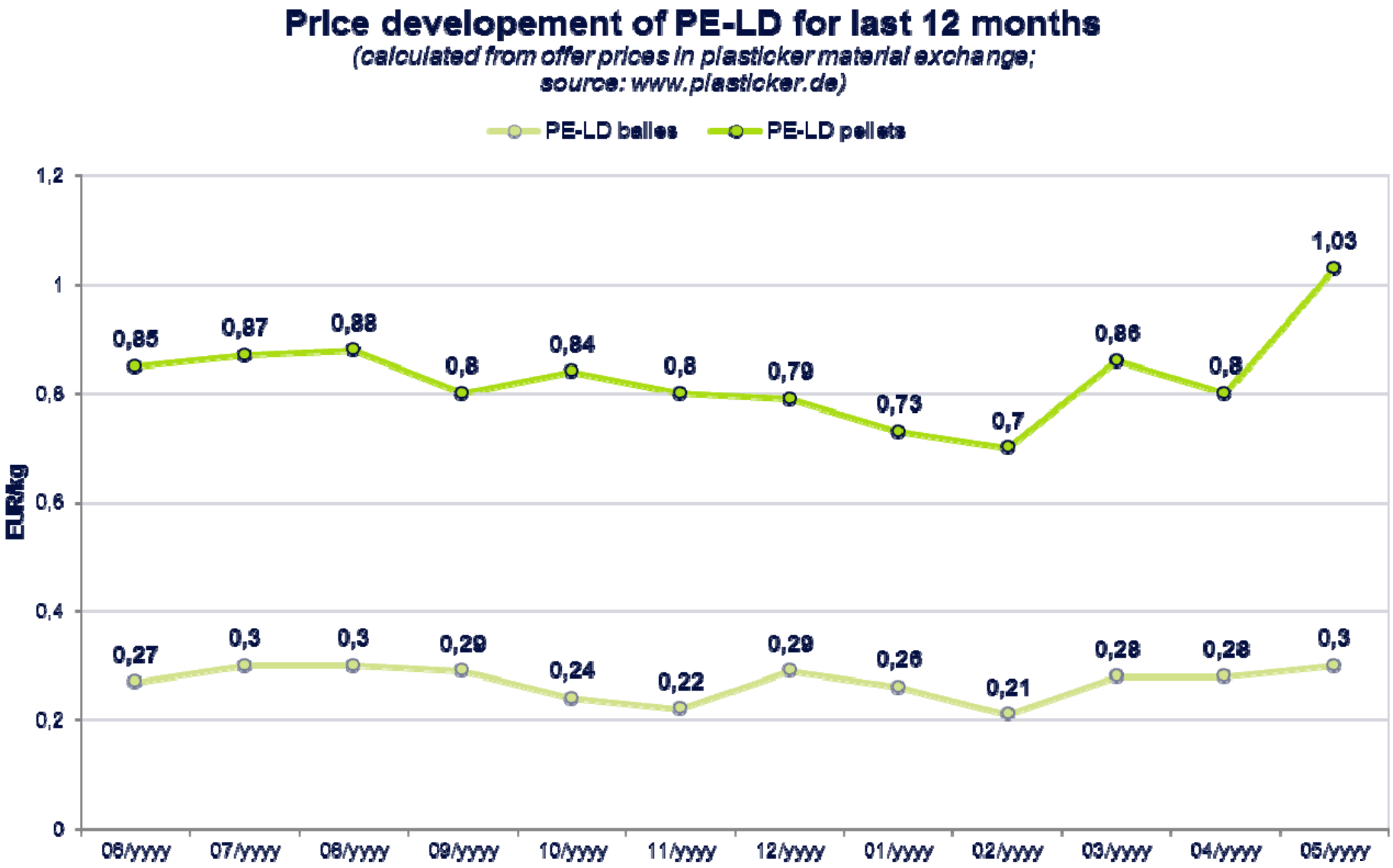
Urban mining aspects

- The advanced EU Member States have been using rather **sophisticated systems for urban mining of plastics**. There are systems of separated collection of plastic waste in the municipal sector (from residents) or from industries, offices, shopping malls and small businesses (European Commission, 2011, 2013). Typically, a waste collection company transports the wastes from special containers on the site.

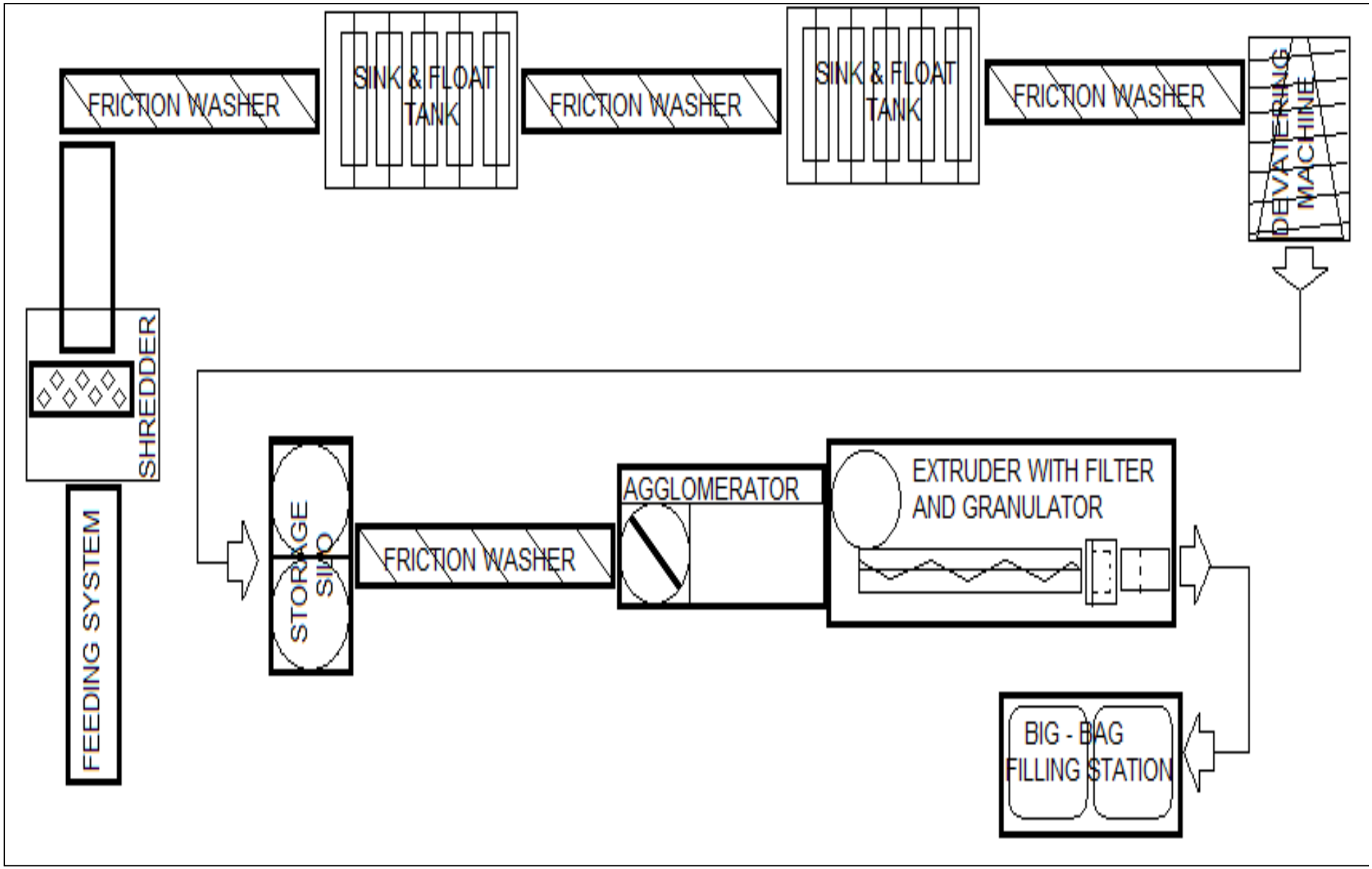
- If more plastic wastes are available, the primary selection of plastic waste types, incl. LDPE, is done straight on the site. **The separated LDPE is pressed / packed in order to streamline transport onto the pre-treatment site.** It would be possible to recycle in a short time as much as 50 % of the produced LDPE waste.

- **Input prices** (purchase of LDPE from waste producers) and **output prices** (LDPE granulate) depend on many factors and there is not a direct dependence.

Course of prices for sorted LDPE in bales and of pellet prices for the production of LDPE film



Technology lines for pellets production



Technology lines for pellets production

The company SUEZ developed the technology line for LDPE processing (production of the pellets), which consists of following units:

- The *feeding system* which transports the material into a crusher. The crusher of a sufficient design and capacity which removes also crushed materials into a washing process.
- The washing process consists of three c*entrifugal friction washers* and two *sink-and-float tanks*. At the end of the washing process, there is a *dewatering machine* with sufficient efficiency.
- The pneumatic system transports the dry crushings into a *storage silo* where the crushed material is stored before regranulation.
- The regranulation uses an *agglomerator* and a unit which feeds the agglomerate into the feeding hopper of the *extruder*. Then, there is an extruder of a sufficient capacity with a continuous filter which filters the molten plastic. There is also a pelletizing unit.
- At the end there is a storage silo where the pellets are stored and a big bag filling stations where *the pellets are filled into big bags*.

Line capacity

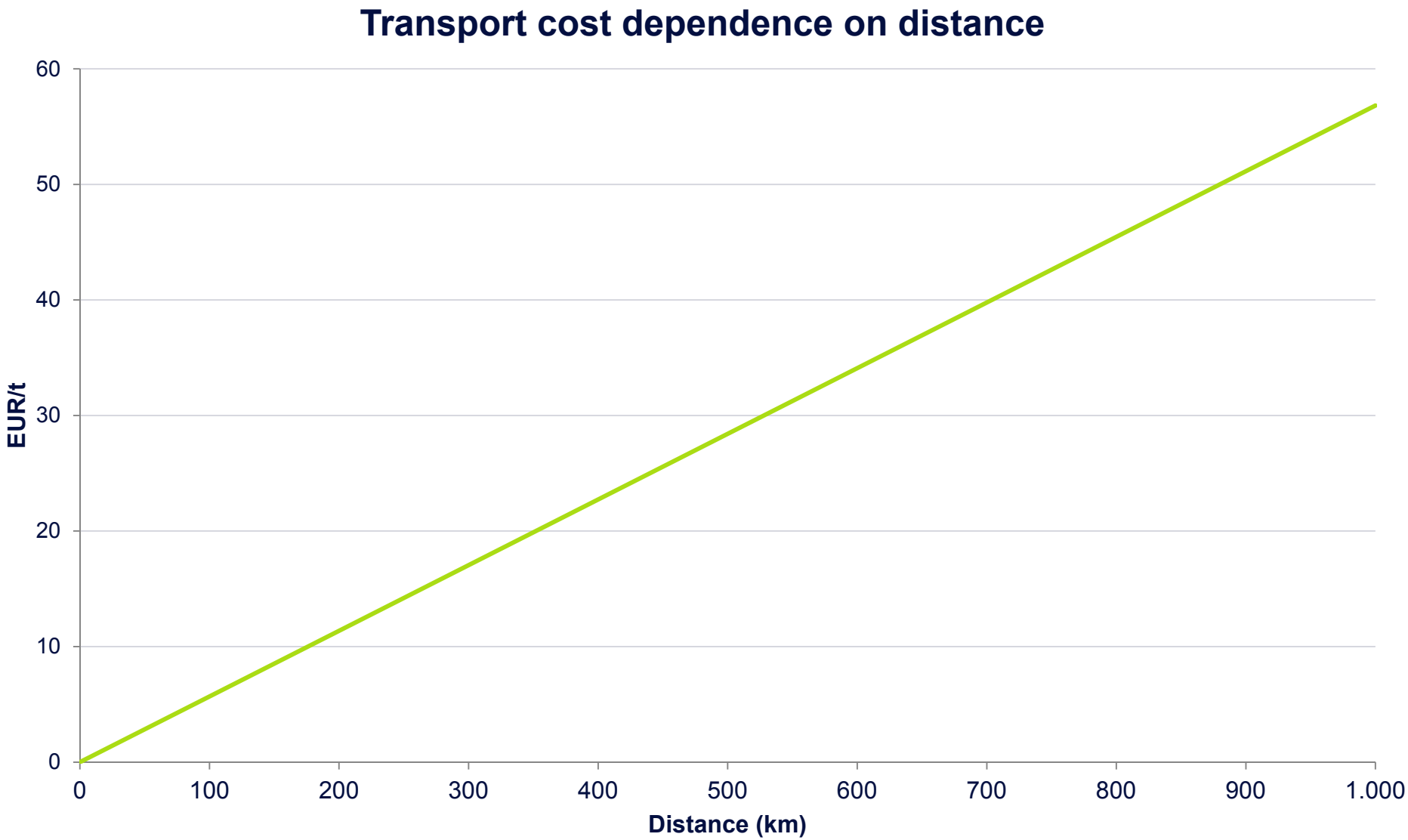
Prototype models were prepared for basic financial plans of the lines with capacities 3,500 and 5,000 tonnes per year. Table shows the results for same input and output values in the both lines.

item\capacity	3500 t/year	5000 t/year
CAPEX (thousand CZK)	61,012	62,132
Real production (tonne/year)	3,438	4,910
Selling price (CZK/tonne)	21,787	21,787
Revenues (CZK/tonne)	74,904	106,974
Direct costs (thousand CZK)	57,522	74,725
Gross income/Gross margin (thousand CZK)	17,274	32,247
Gross income/gross margin (%)	23.1	30.1

Essential features used in the design of the LDPE (low-density polyethylene) recycling centres

- Distance to transport plastic waste from the pre-treatment facility to the location of final processing
- Proportion of different types of LDPE film (coloured clear, dirty, etc.) due to the significant price difference in purchase prices
- Re-granulation and pellet production line capacity
- Quality of output material

Transporting distance



Maximum transporting distance = 200 km

Proportion of different LDPE films

The key factor which is decisive for general success of the waste plastic recycling project is a suitable mix of the treated plastic films. If the line is extended on the washing side (a double washing process) and a quality filter is installed for the molten plastic, the following mix can be used:

- 1/3 clear transparent film
- 1/3 slightly dirty transparent film
- 1/3 coloured, clear or slightly dirty film

Other combinations are also possible – the situation in the waste collection area should be, however, considered. The objective is to optimize the chance to penetrate onto the waste collection area but still one needs to keep in mind that it is only the final product of top quality which can be sold on the market.

Quality of output material

Conclusions

Considering our prototype models above, which issue from urban mining, the following conclusion should be drawn, in order to increase the recycling of plastic wastes it is necessary to integrate promptly the circular economy into all EU Member States. The packages which will support the circular economy should include following measures:

- To increase landfill fees in countries where less than EUR 40 is paid for one tonne of waste.
- To forbid the landfilling of recyclable wastes at waste landfills.
- To use EU funds for support of the recycling and processing industry.
- To reduce taxes (particularly the VAT) for products which contain a certain quality of recycled waste.

Conclusions

- To support research and development in recycling, reuse of waste and ecodesign.
- To support universities, specialized laboratories and research departments which focus on the recycling and processing industry.
- To support certification of products with a certain content of the recycled waste by means of green product/eco-label/certification for products which are fully recyclable after end of life, or to use a carbon tax.
- To support development of local business for recycling and treatment of wastes in certain regions with high unemployment with necessary logistic components (the sorting lines, reloading sites, platforms for preliminary treatment of wastes).

THANK YOU FOR YOUR ATTENTION
QUESTIONS?

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