Local logistical management in the cold food supply chain by using intelligent packaging devices

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Loss of income per year caused

by expired perishables in

The Netherlands is estimated at:

500 million Euros

5-10% of turnover of the retail

About 30% in the supply chain

How to create a Food Supply Chain for
perishable chilled products with
less spoilage and energy consumption?

# Consumer meat packaging with printed sensor

- Data logger with
- quality decay model and initial quality set, related to:
  - Temperature
  - RH
  - Gas conditions
  - Bacterial growth
- Electronic display to visualize a dynamic expiry date,
- Instead of a fixed date

communicative packaging

Sustainable food logistics:

-One-time use of fibre packaging (biodegradable)

-communication with information at the package

-printed organic electronics with temperature sensor (RH)

-decision support system local on the package or contact to central office.

Research in
EU KP6 project SustainPack

Logistic path

Qualities ?

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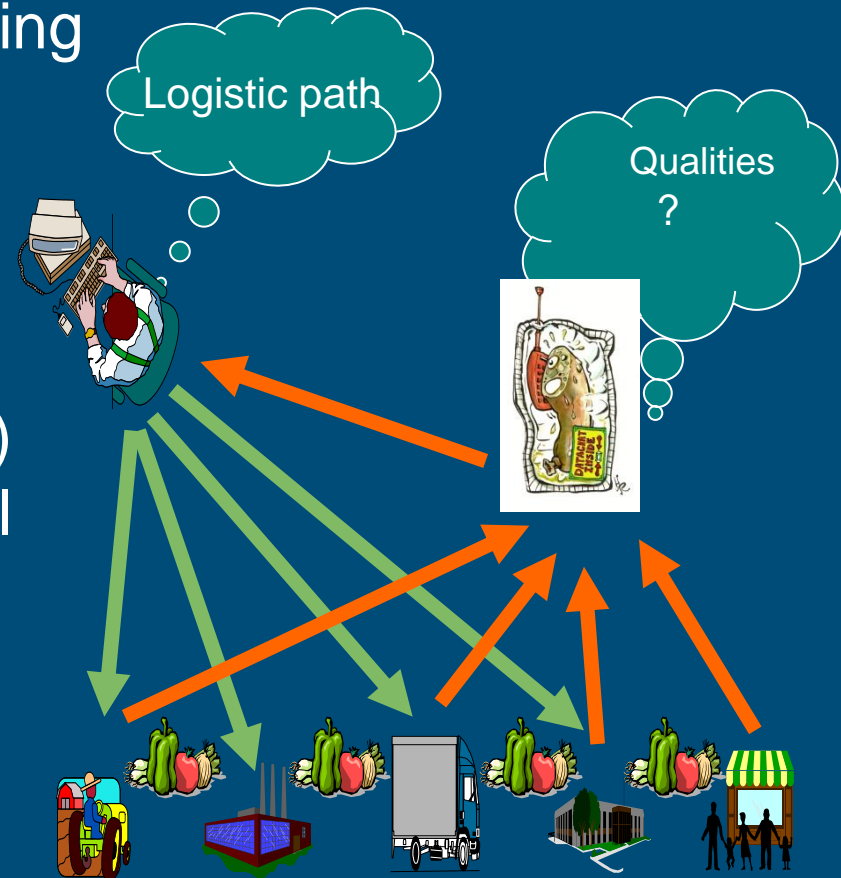
Future in communication on the package

- Complex intelligent RFID/databar systems with chips will be accepted in next years
- RFID printed electronics will grow 15x in 10 years
- The price of the passive "chip RFID tags" will reduces from €0.05 - €0.15 to €0.01 in ten years.
- Printed tags will even be lower in price
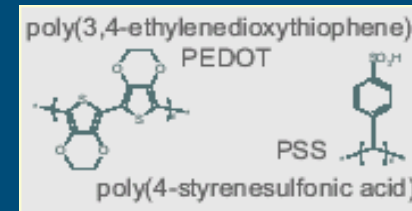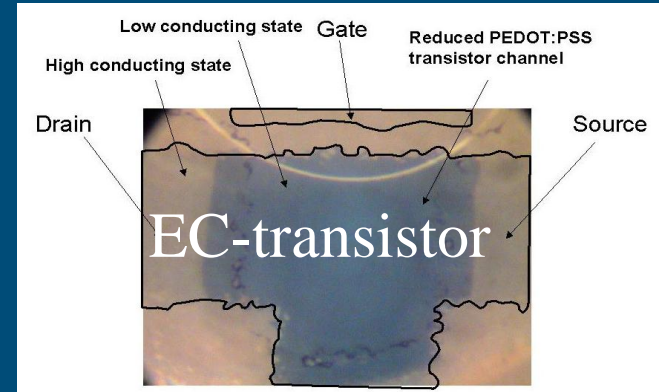
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Printed Electronics

Printing machine specially equipped for printing organic electronics. With e,g.; flexo-printing, rotative screen, lamination, cutting etc, roll-to-roll 30 cm wide, 5 – 120 m/min printing speed.
Ref: Acreo and Linköping University

Drain — EC-transistor — Source

Low conducting state — Gate — Reduced PEDOT:PSS transistor channel — High conducting state

poly(3,4-ethylenedioxythiophene) PEDOT
PSS
poly(4-styrenesulfonic acid)

Semi-cond. / Cond. / Non-cond. — Reversible — Reduced / Pristine / Oxidized / Over-oxidized — Irreversible

Fig 1 Example: The tile PEDOT – PSS polymer system, useful for e.g. all-organic transistors. The polymer system can show conductive, semi-conductive but also non-conductive properties.
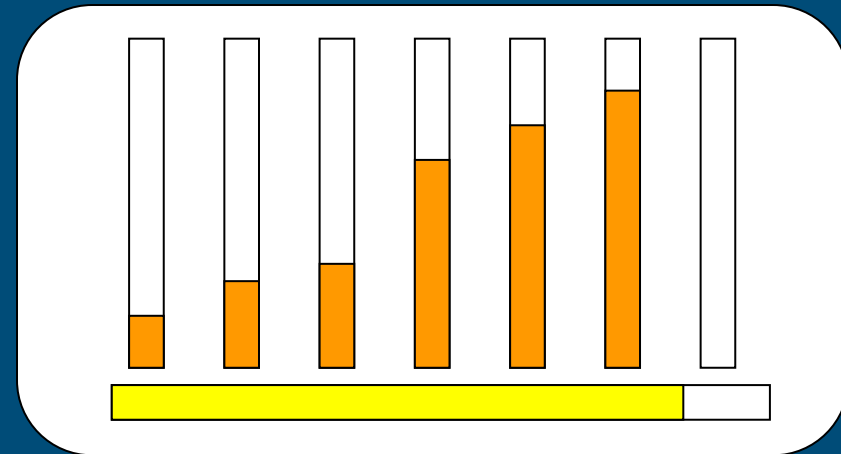
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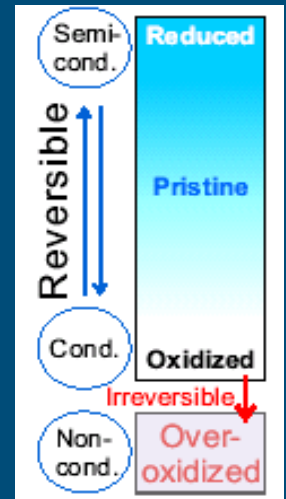
Temperature Logger

■ **Intelligent tag with displays, temperature sensor**
and decision algorithm

Specifications:

- T and t range and accuracy
  - 1or 2 weeks with 5 to 10 intervals
  - 3 integrated temperature levels:
    <5, 5-15, >15
- Label size 85 mm x 55 mm
- Changing data (allowed by law)
- Start button
- Read-out (date, also price possible)

Sainsbury's

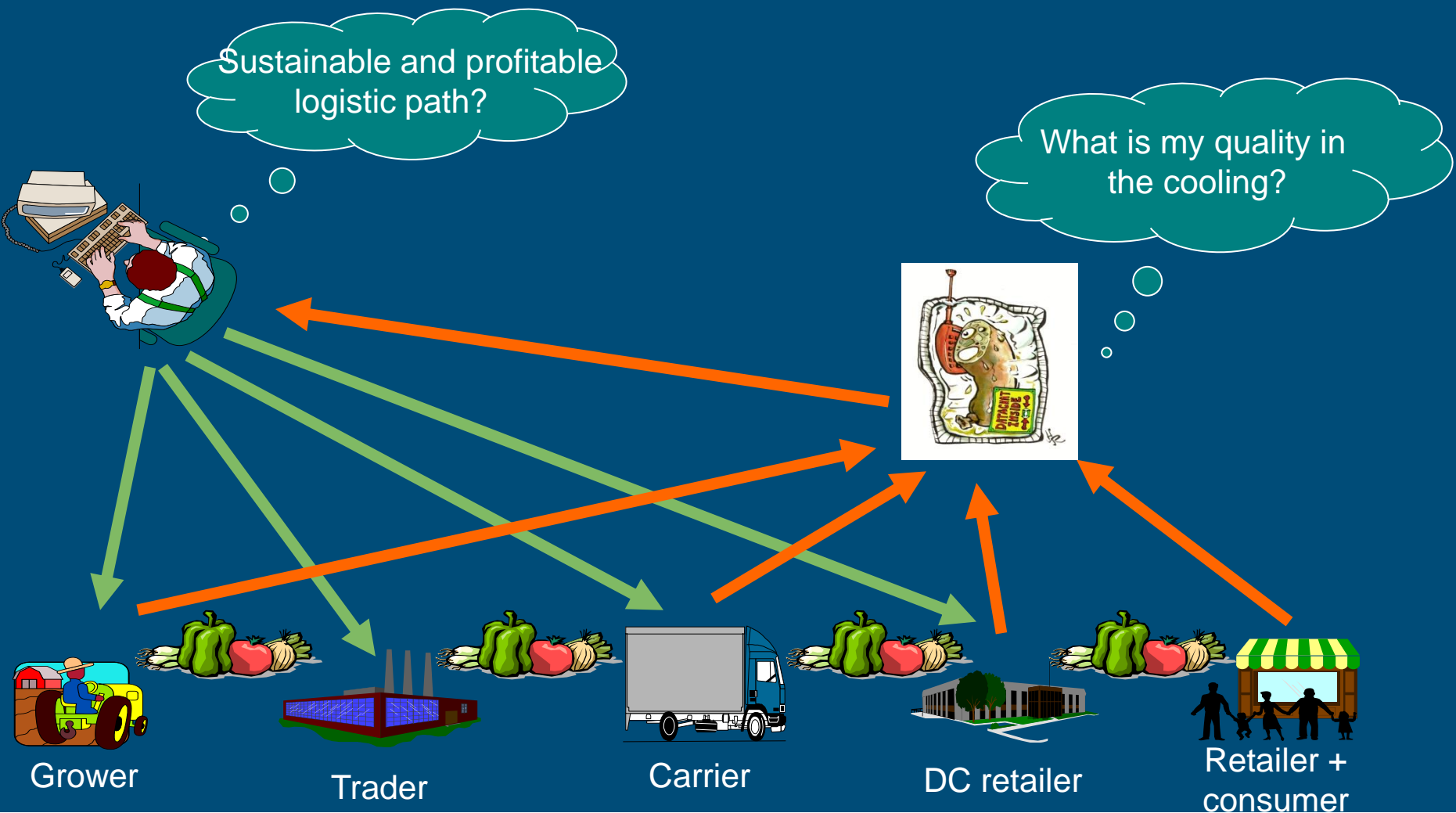Price: € 3.98

Use by: 17-03-06

Meat product

500 grams

8 21935 11112 4

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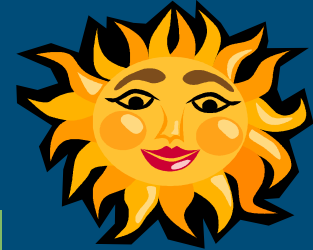# Less product losses/wastage in the food chain

Dynamic Expiry Date for the cold chain

Temperature depended quality decay model
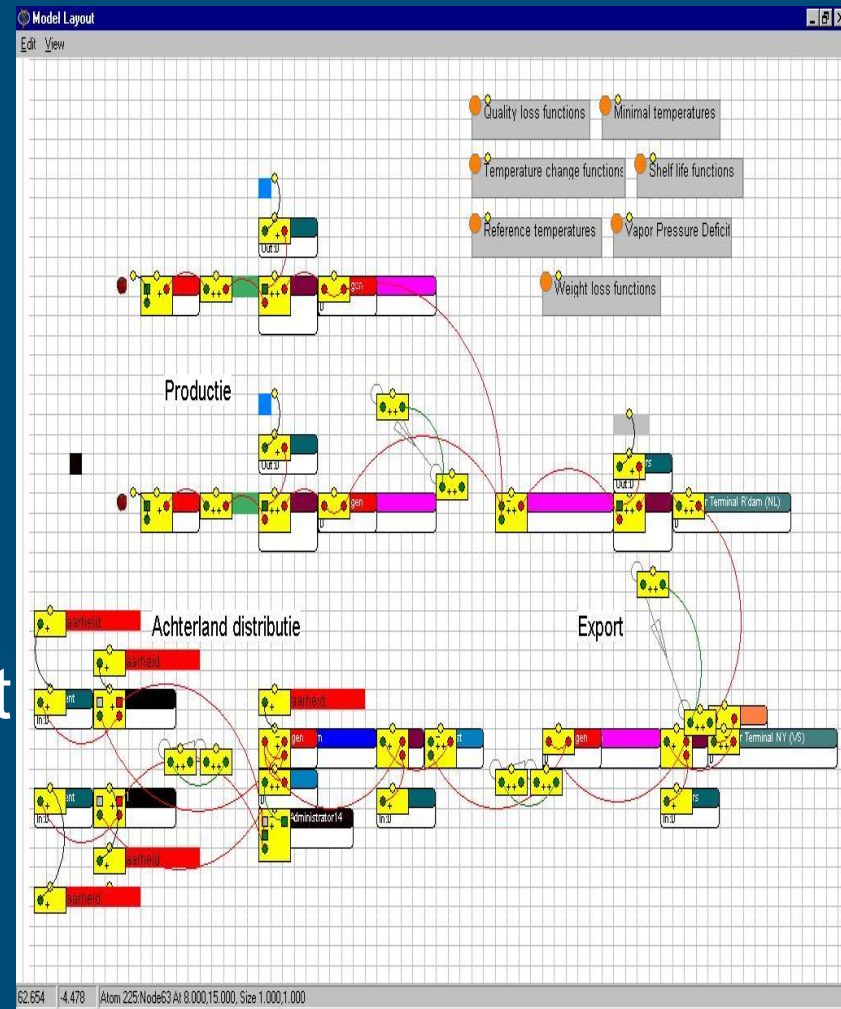

quality

Acceptance level

T1 > T2 > T3

t1   t2   t3   time
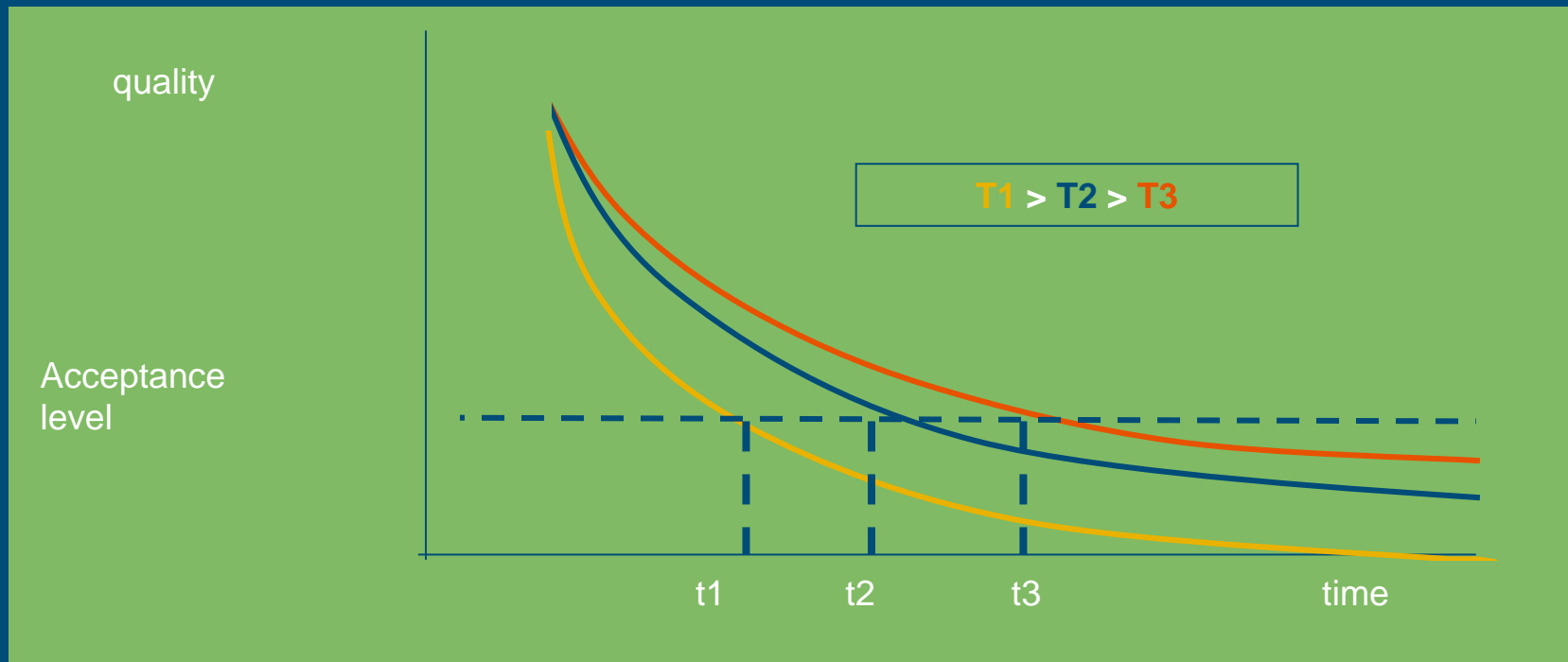
Computer simulations to quantify economic impact

- Software tool: ALADIN (Enterprise dynamics)

- Logistic performance taking into account product quality through the chain

Input parameters simulations

- Pork chops 340 gram per pack

- Quality decay model: bacterial growth on meat

- Input parameters model:
  - Temperature profile during distribution chain
  - Initial bacterial load
  - Acceptance level

- Based on data from a Dutch supermarket

- Fixed Expiry Date is production date + 5 days

- Spoilage/waste takes place when the package is not yet sold at the last day of the expiry date

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Economic impact: opportunity losses

Assumptions:

- Selling price: 2 Euro per package
- Cost price: 0.96 Euro per package
- Gross profit margin: 52%
- Discount last day (before expiry date): - 30%
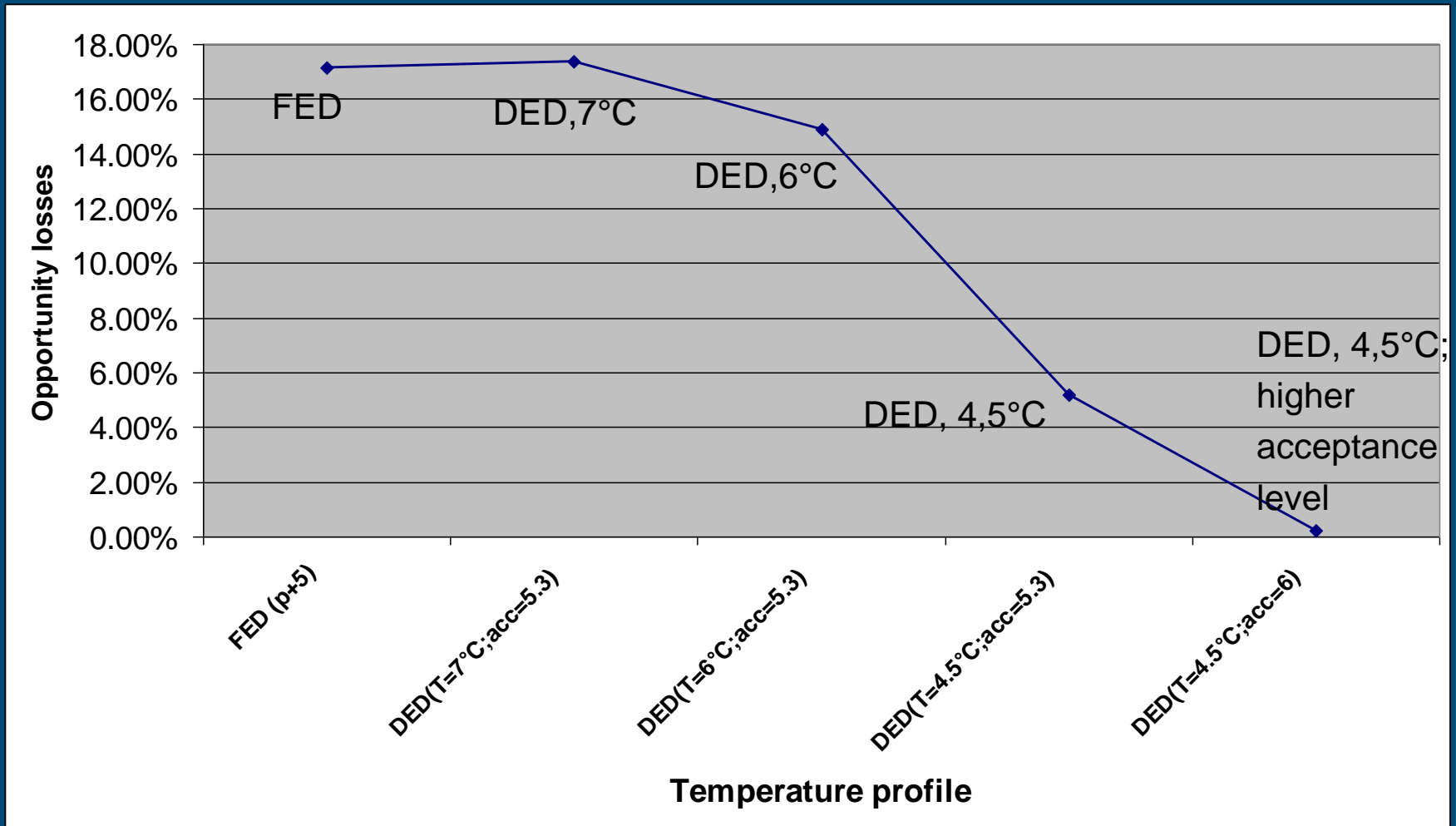- Selection behaviour is influenced by price change.

Variables:

- Also: ACC or microbiological acceptance level for spoilage of 5.3 or 6 log at a temperature of 7ºC
- Temperature setting of the cabinet: 4.5 ºC, 6 ºC, 7 ºC

Economic impact: opportunity losses

- Waste losses: number wasted packages x selling price

- Losses due to discount (30%):

  number packages sold with discount x 0.3xselling price

- Losses due to out of stock:

  number of demanded packages x margin

- **Opportunity losses =**

  waste losses + discount losses + out of stock losses

- Margin on sales = number of sold packages x margin + number packages sold with discount x (0,7xselling price – cost price)

- **% opportunity losses = opportunity losses/margin**
  on sales

Results simulation – different temperature profiles
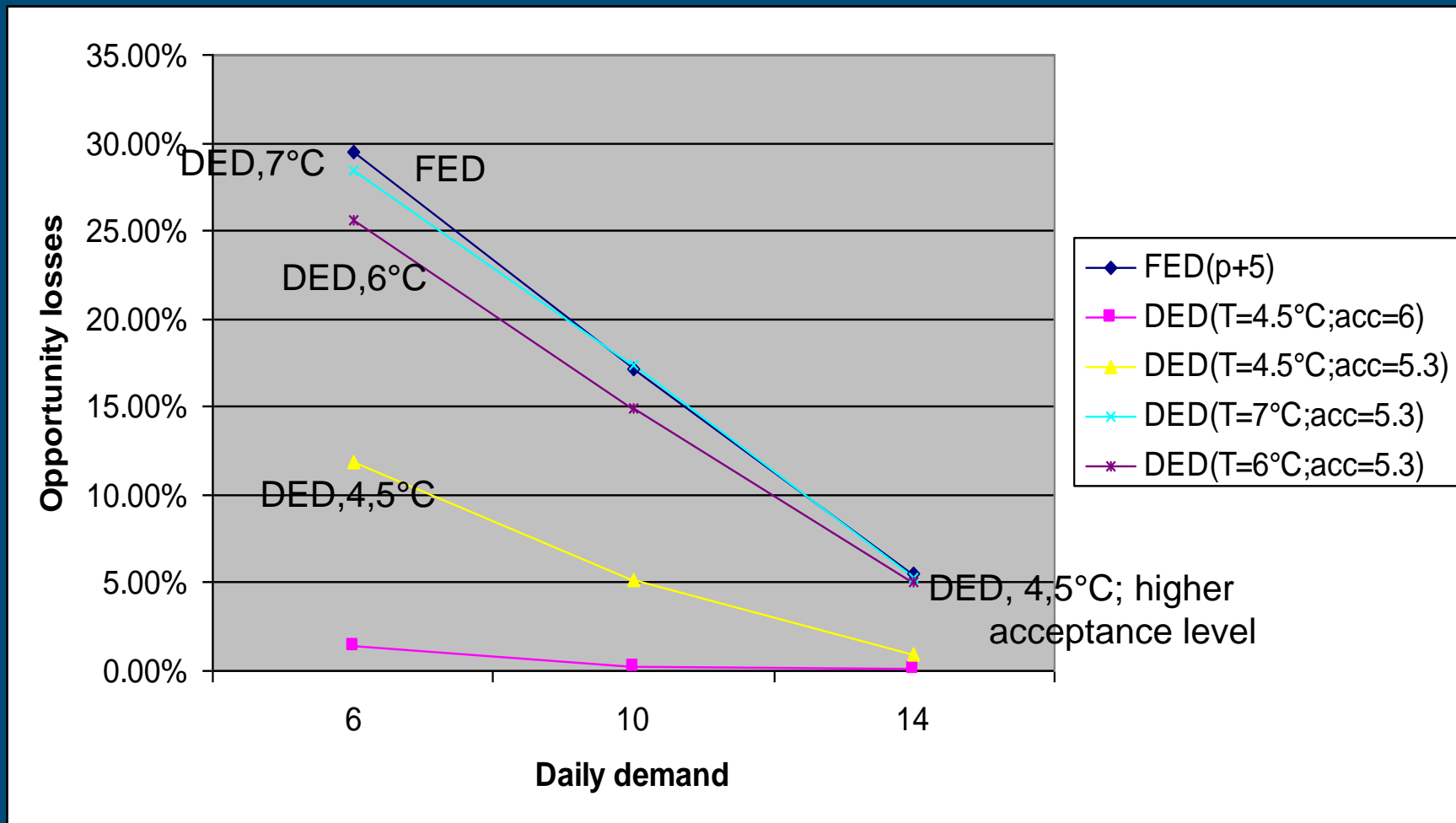
Aspects for the amount of spoilage at the retailer

- Shelf life of product: fixed FED or dynamic DED

- Temperature control (replenishment of the shelf with temporary high temperatures of carriers) and temperature distribution in the cabinet: Local temperature differences are compensated by the DED. No additional lowering of the cabinet temperature for controlling the shelf life overall.

- Daily demand (amount units sold per day: fast movers against slow movers (last give opportunities for DED)

- Ordering policy (replenishment level)

- Selection behaviour (% of consumers that pick up the units with the longer expiry date on the shelf)

Conclusions

- The application of the DED concept for perishable products can reduce the opportunity losses from 18 to almost 0% for the best case scenario or to about to 5% for a realistic scenario.

- Smaller temperature margins needed for the cold cabinet

- Takes into account individual changes in the environment

- The Intelligent tag gives a visual (or via RFID) decision about the shelf life on package level, giving less rejection (as with pallets etc.).

- Individual decisions give lees rejection than grouped decisions

- Can also be used in the house holding to help to decide if the food is still fresh in the refrigeration

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Thank you.
Questions?

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