



Reifenhäuser

The Extrusioners

Technical solutions for today and tomorrow's PE film production

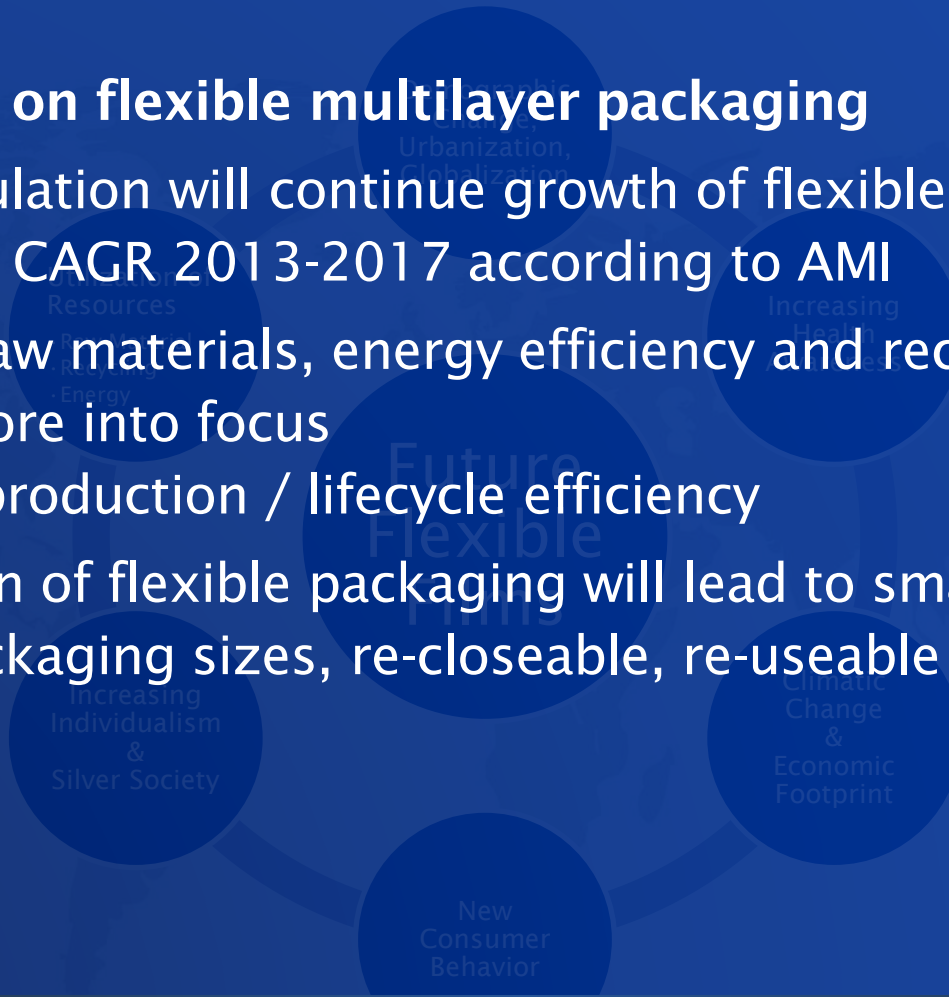
Steve DeSpain, Reifenhauser Incorporated



Global Megatrends and their impact on flexible films

Major impacts on flexible multilayer packaging

- Growing population will continue growth of flexible films demand
→ approx. 7% CAGR 2013-2017 according to AMI
- Selection of raw materials, energy efficiency and recycling will come even more into focus
→ increased production / lifecycle efficiency
- Sophistication of flexible packaging will lead to smarter packaging
→ smaller packaging sizes, re-closeable, re-useable



Global Megatrends and their impact on flexible films



- The Next Billion Consumers: \$10 Trillion
- Everything the Same but Nicer: \$5 Trillion
- Keeping the Wealthy, Healthy: \$4 Trillion
- The Growing Output of Primary Inputs

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The Global Middle Class and Global Flexible Packaging



By The Numbers



- 1.8 Billion People in the Middle Class
- 3.2 Billion Expected by 2020
- 4.9 Billion Expected by 2030
- 66% of Global Middle Class Represented by Asia
- 1 Billion Chinese as Part of Middle Class by 2030

Source: FPA



World Flexible Packaging Market 2016 Total \$86 Billion

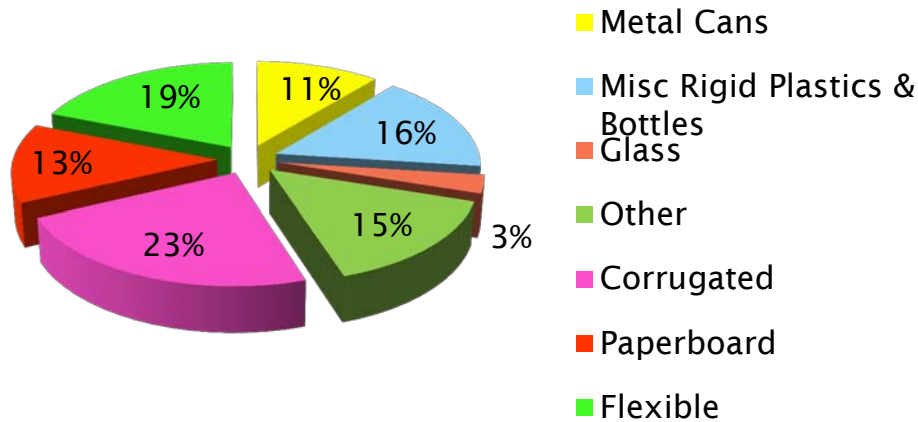
COUNTRY / REGION	% Flexible Packaging Market	Population in Millions	% World Population	Per Capita Consumption in US \$
Europe	21	739	10	24.43
N America	27	363	5	63.93
Total-Developed Countries	48	1102	15	37.45
C & S America	6	648	9	7.97
Asia Pacific	41	4518	60	7.80
Africa / Middle East	5	1247	16	3.45
Total-Developing Countries	52	6413	85	6.97

Source: PCI Films Consulting per Flexible Packaging Europe Presentation at 2017 FPA Annual Meeting, Population Reference Bureau and Flexible Packaging Association

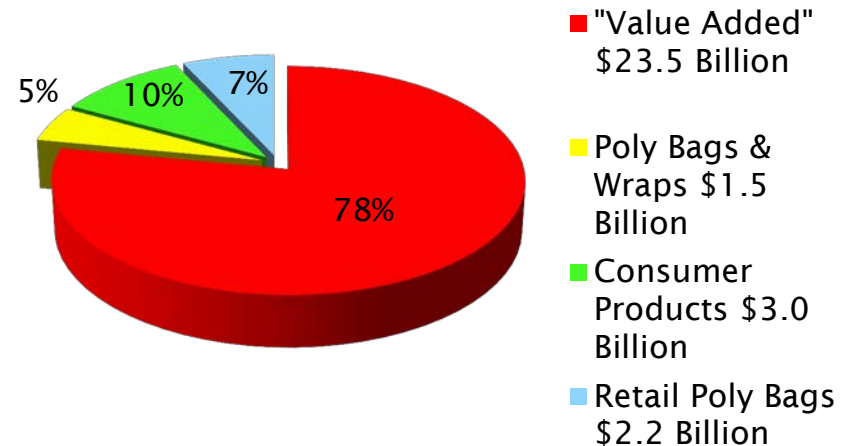
U.S. Packaging Industry



Total U.S. Packaging \$164 Billion



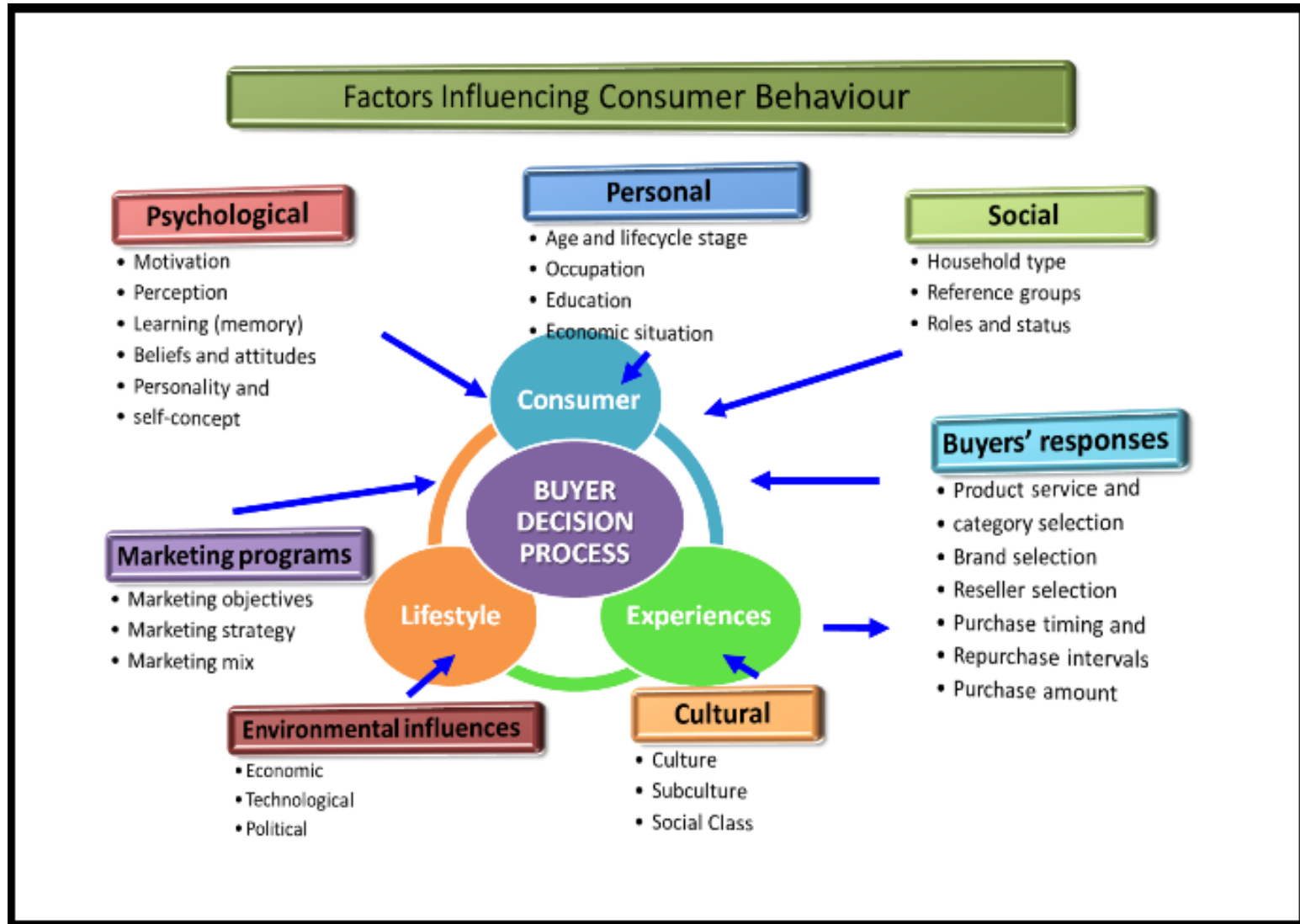
Total Flexible Packaging: \$30.2 Billion



Source: U.S. Census Bureau 2015 ASM Census and FPA estimates for 2016 total revenue

Impact 1:
Growing population will continue the growth of flexible film demand and requires flexible and advanced extrusion systems.

As Consumer Behavior Goes, So Goes Branding and Packaging



Functionality Creates Opportunity

- Portability
- Portion Control
- Convenience
- Freshness
- Sustainability



Top 10 Global Consumer Trends

Consumers are more demanding of products, service and brands

- Ageing
- Consumers in training
- Extraordinary
- Faster Shopping
- Get real: The allure of authenticity
- Identity in flux
- Personalize it
- Post purchase
- Privacy & security
- Wellness as status symbol

Ageing



- More than a quarter of the people on Earth are over 50
- Growing contingent of active and productive people who are working longer and taking the economy in a new direction: “longevity economy”
- Disruptive aging: “Midorexia”
Middle aged consumers who act younger than their years “50 is the new 30”



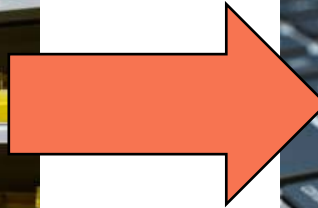
Personalize it

- Personalization is not limited to luxury anymore
- Products that fit you....and learn about you (websites proposing products and digital engagement)
- (Personalized) Subscription services (fashion, wine, coffee,....)
- This trend changes consumer expectations; brands need to fulfil and even predict needs



Purchase decision moves online

The traditional way of shopping has changed





U.S. Flexible Packaging Overview

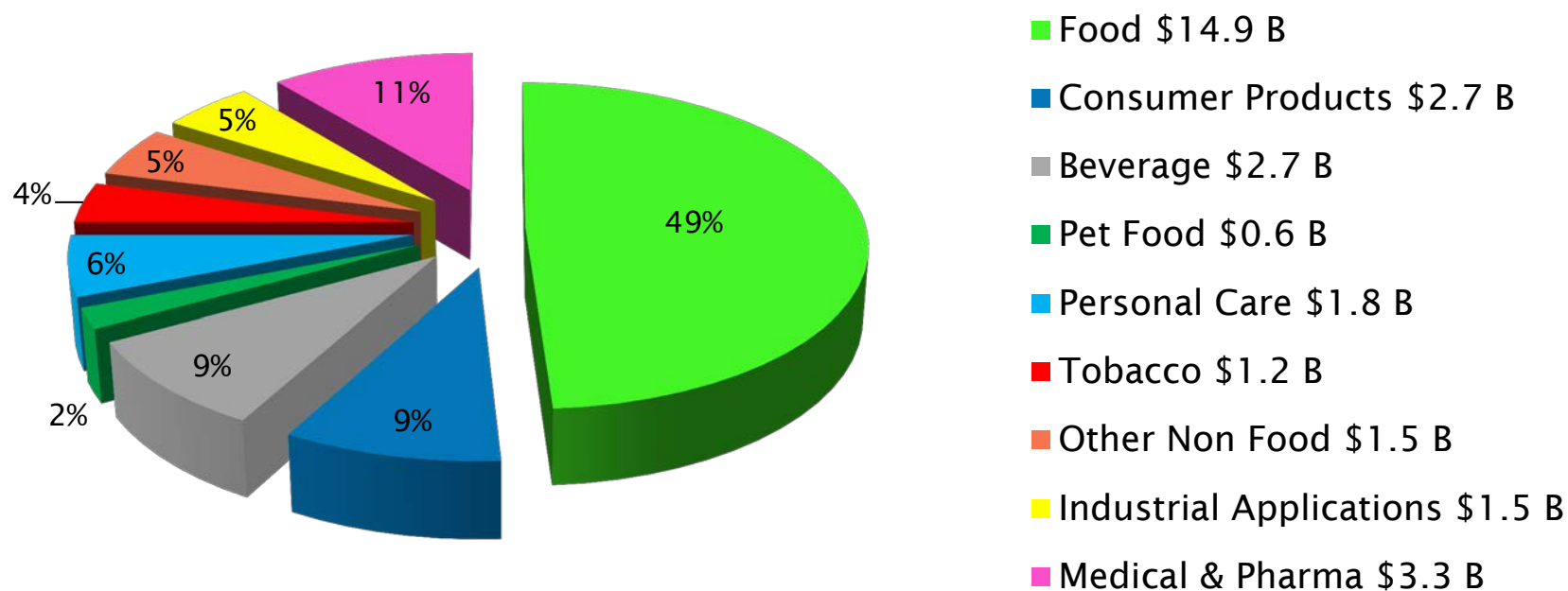
Metric	2000	2009	2016
Number Companies	665	410	426
Manufacturing Facilities	1010	970	954
Employees	89 Thousand	<80 Thousand	79 Thousand
Sales per Employee	\$221K	\$290K	\$383K

Source: U.S. Census Bureau and Flexible Packaging Association 2001 and 2010 State of the Industry Reports and 2016 State of the Industry Survey preliminary data

U.S. Packaging End-Use Markets



Flexible Packaging Sales by End-Use Market: \$30.2 Billion



Source: FPA 2016 State of the Industry Survey Preliminary data

**“Imagine if you could run
your press at full speed with
perfect print quality.”**

Converter's Film Requirements

Major Criteria



EFFICIENCY

- Printability/Register accuracy
→ **quality**
- Printing speed
→ **output**
- Type of films
→ **flexibility**

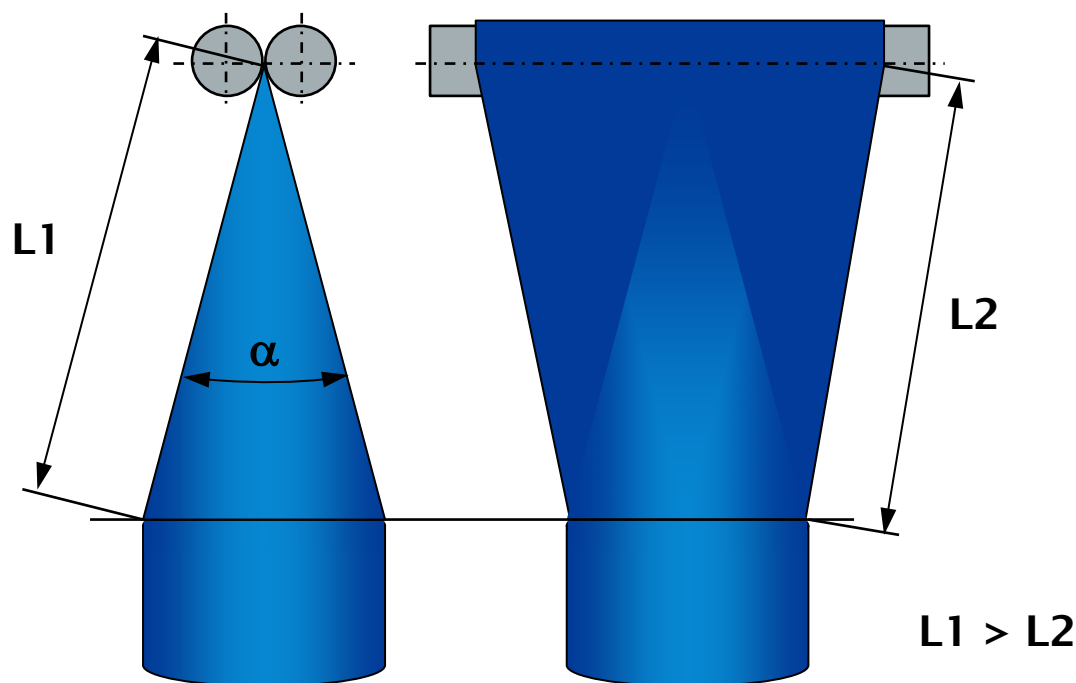


Examples of film quality enhancement

Definition of camber



Camber of film is caused mainly by different lengths in the collapsing frame



Length differences depend on collapsing angle α ,
e. g. for a collapsing angle 11° : 0.34 % length difference



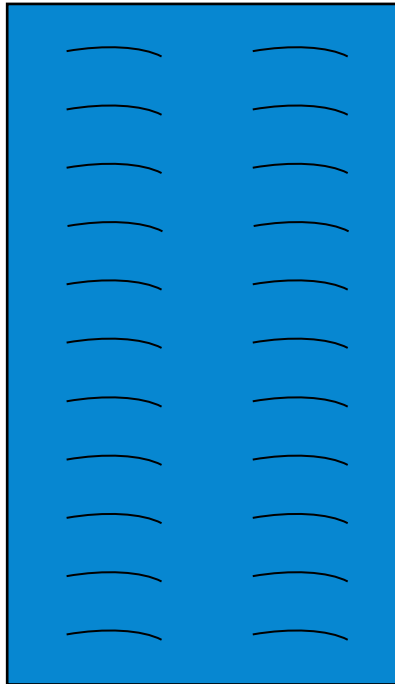
Measurement of camber
at film length 10 m



Examples of film quality enhancement

Definition of flatness

Bagginess in the film are mainly caused by temperature variations



Bagginess
in the film





Take-off System w/Flattening Device



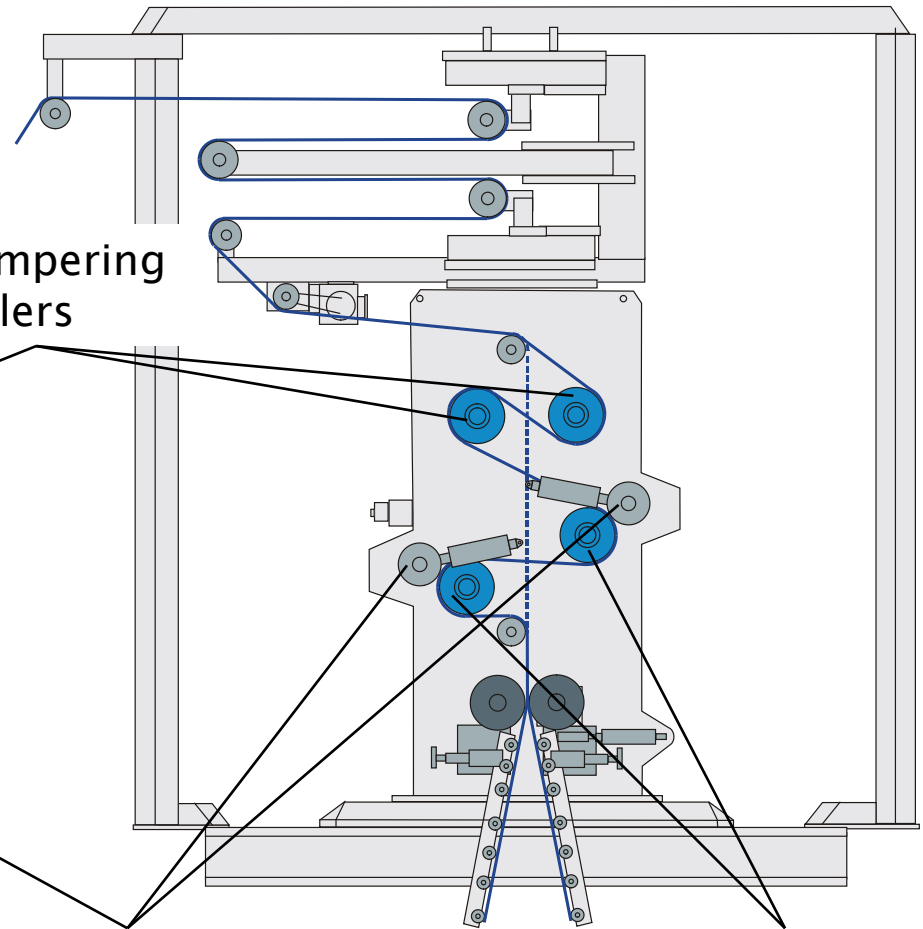
A separate drive for each tempering roller guaranties highest flexibility



Tempering rollers

Lay-on rollers

Tempering rollers





Examples of film quality enhancement

Performance results

improvements on

- Film flatness
- Film camber
- Printing quality
- Printing speed
- Lamination quality

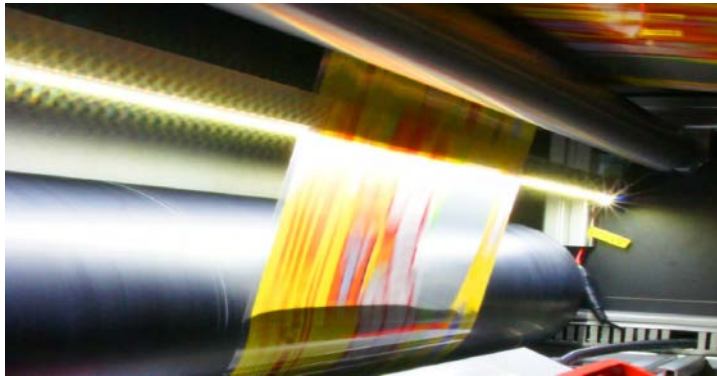






Examples of film quality enhancement

Improvement of film flatness



Real measurement of the film flatness with the optical web tension profile scanner at Fraunhofer IVV, Branch Lab for Processing Machinery and Packaging Technology in Dresden/Germany,

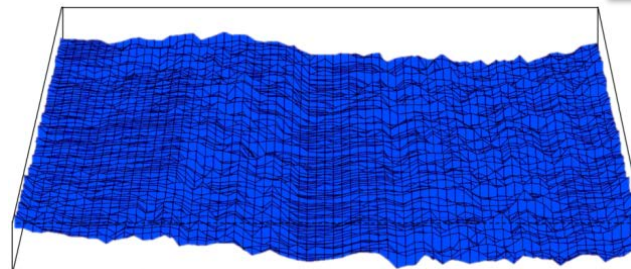
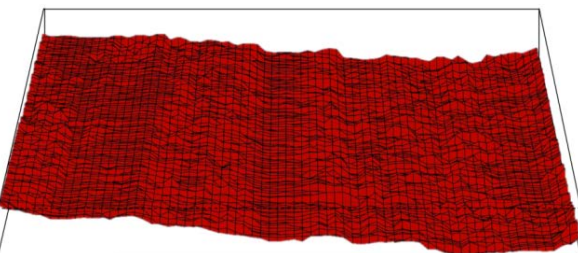


→
- 42 %



Use of the **EVOLUTION UltraFlat** take-off system improves the film flatness significantly

Flatness of this label film improves by 42 % by use of the **EVOLUTION Ultra Flat**





Examples of film quality enhancement

Improvement of lamination quality

Blown film laminated to BOPP
with solvent-based adhesive and with solvent-free adhesive



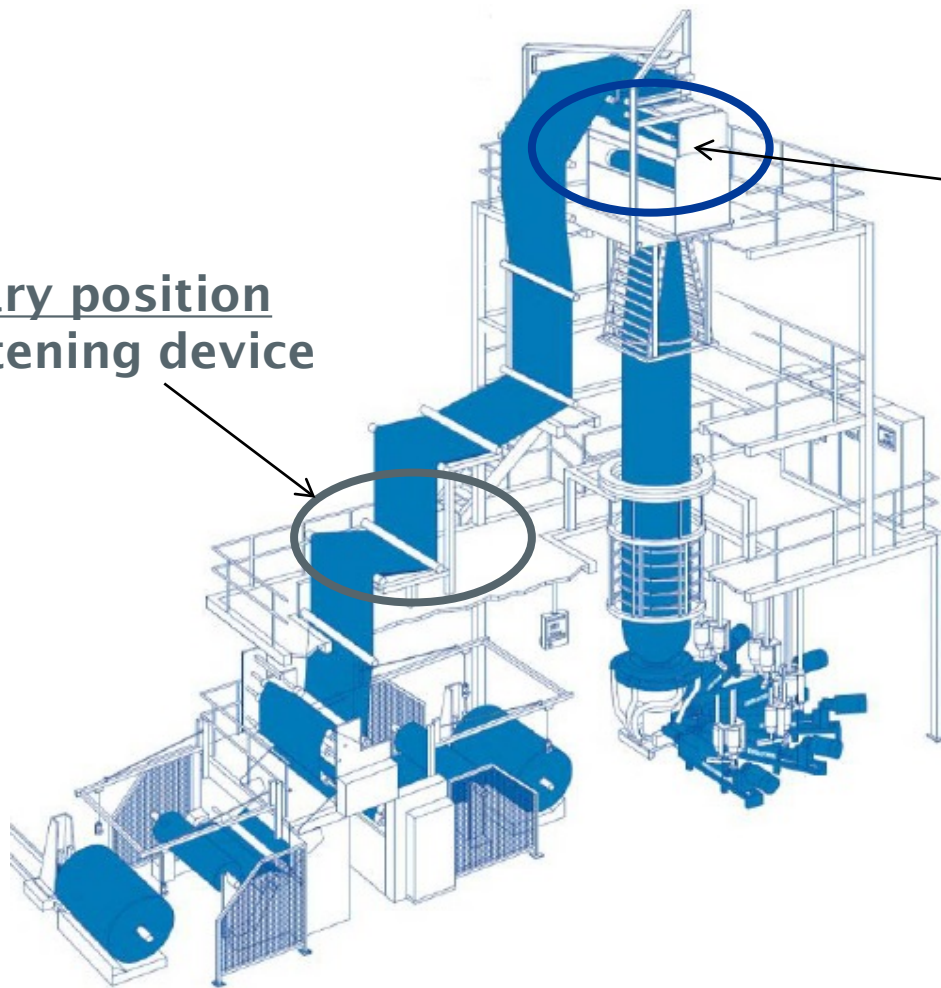
**Significantly improved
converting quality which
results in lower final
production waste**



Flatness Enhancement Comparison of different systems



Ordinary position
of flattening device



New position
Take-off System

Stretching Systems (MDO)

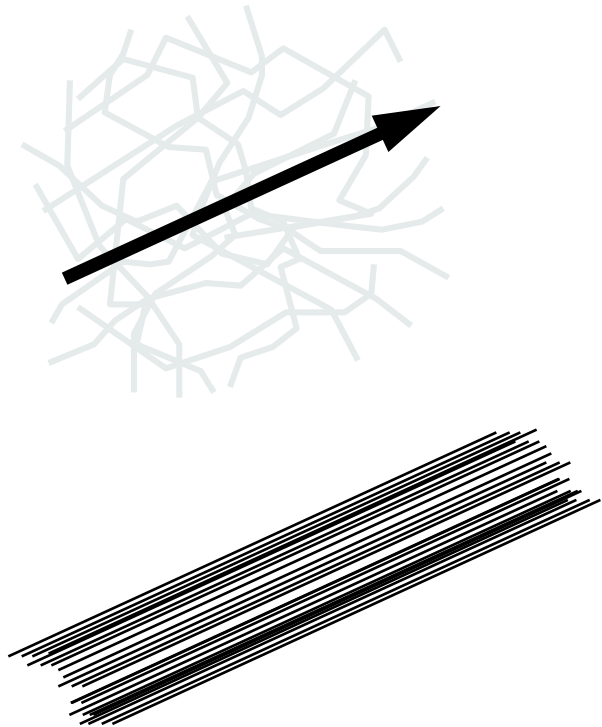
Customer benefits

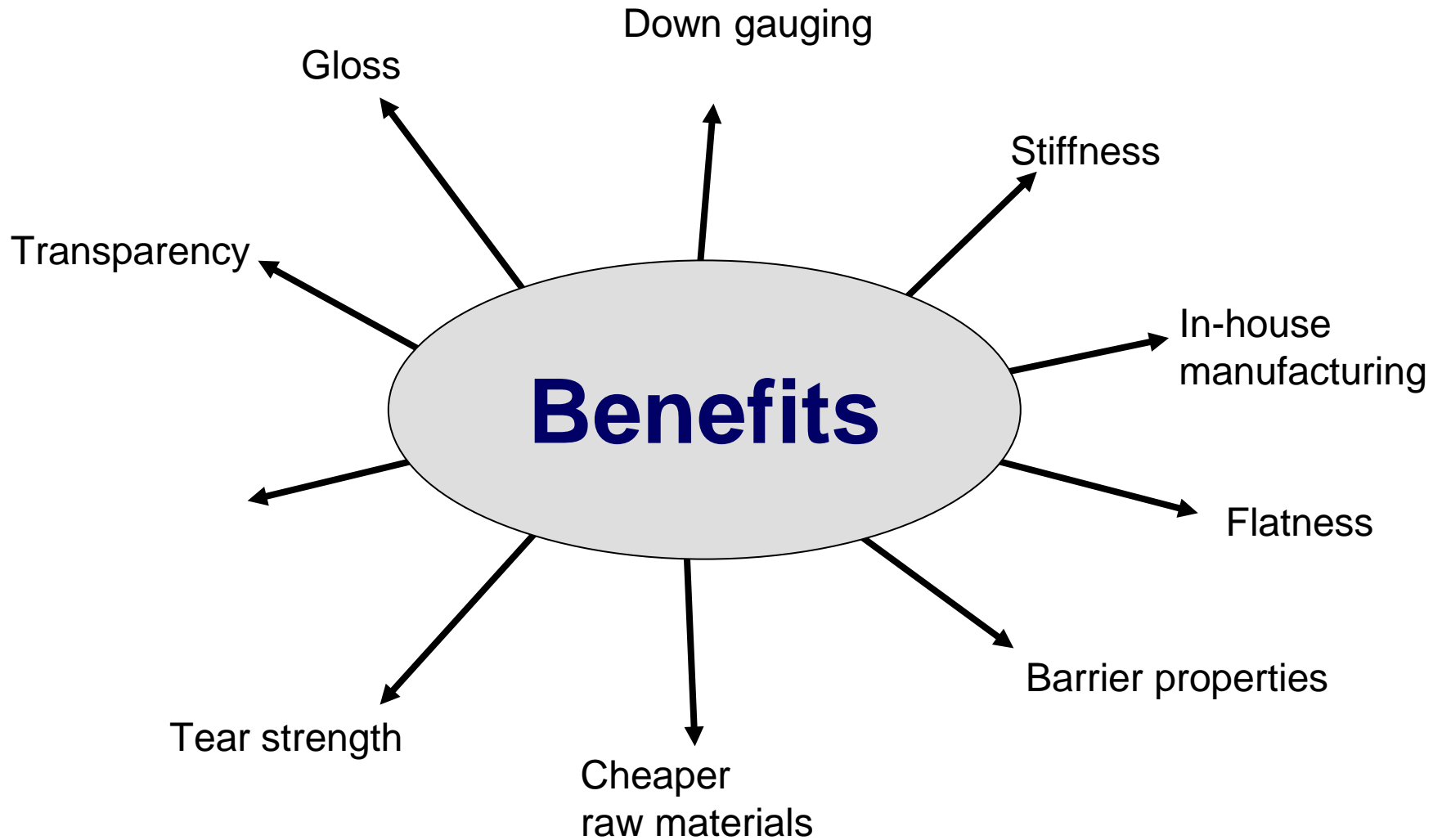
- Design film properties
 - Down gauging
 - Improved mechanics
 - Optimized optics
 - Increased barrier properties



Why is more orientation required?

- to modify physical properties to obtain desired characteristics and/or gain processing efficiencies
- Down gauging
- Stiffness
- Gloss
- Transparency
- Tear strength
- Flatness
- Barrier properties







Why inline configuration?

- Suitable for long production runs
- Reduction of labor costs
- Reduction of waste
- Elimination of an additional production process

Applications for MDO Films



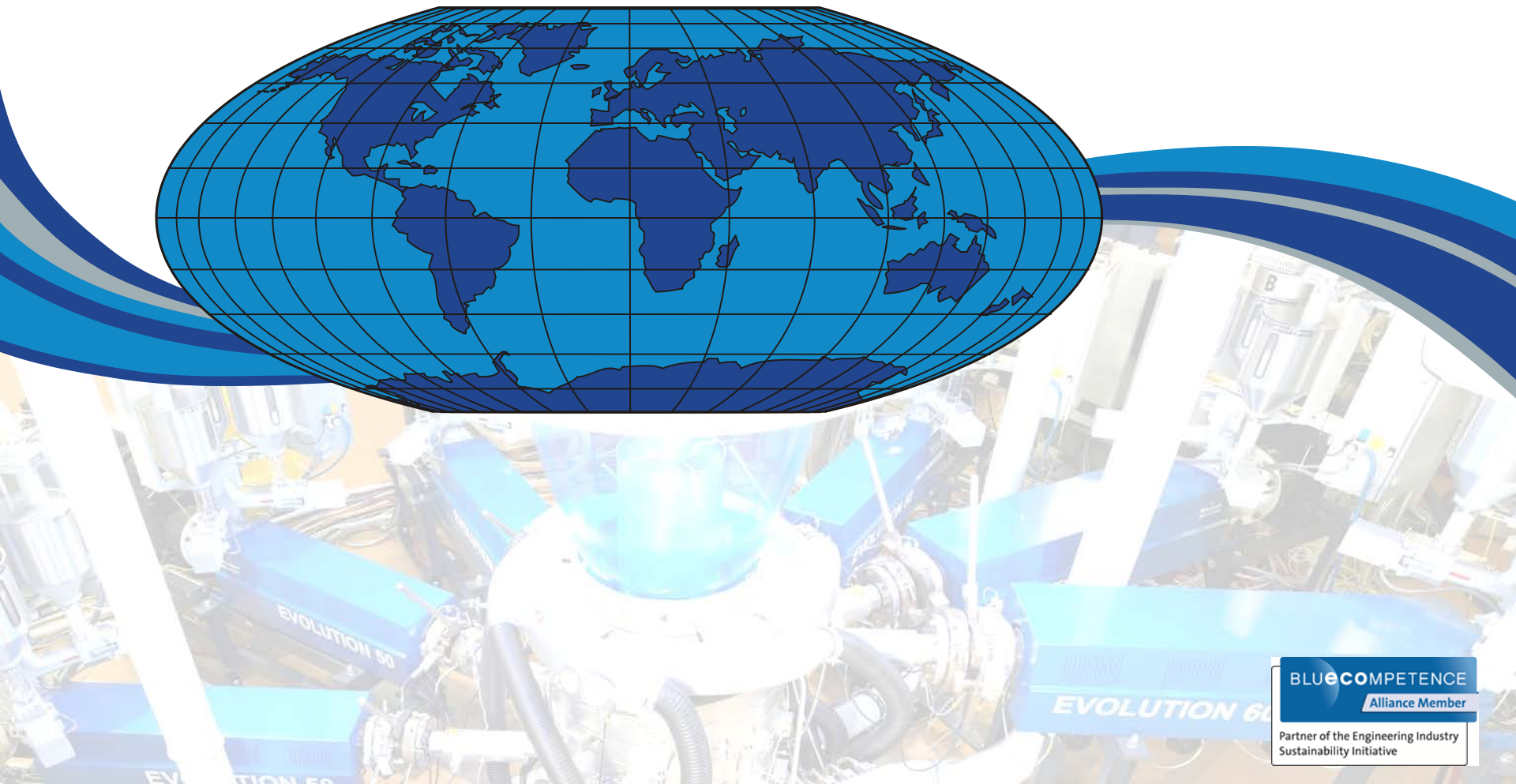
- Stand up pouches
- Shrink wrap
- Backsheet
- Twist wrap
- Frozen food packaging
- Barrier packaging
- Lidding films
- Silage stretch

Impact 2:
Raw materials, energy efficiency and recycling will come even more into focus.



Blue Extrusion

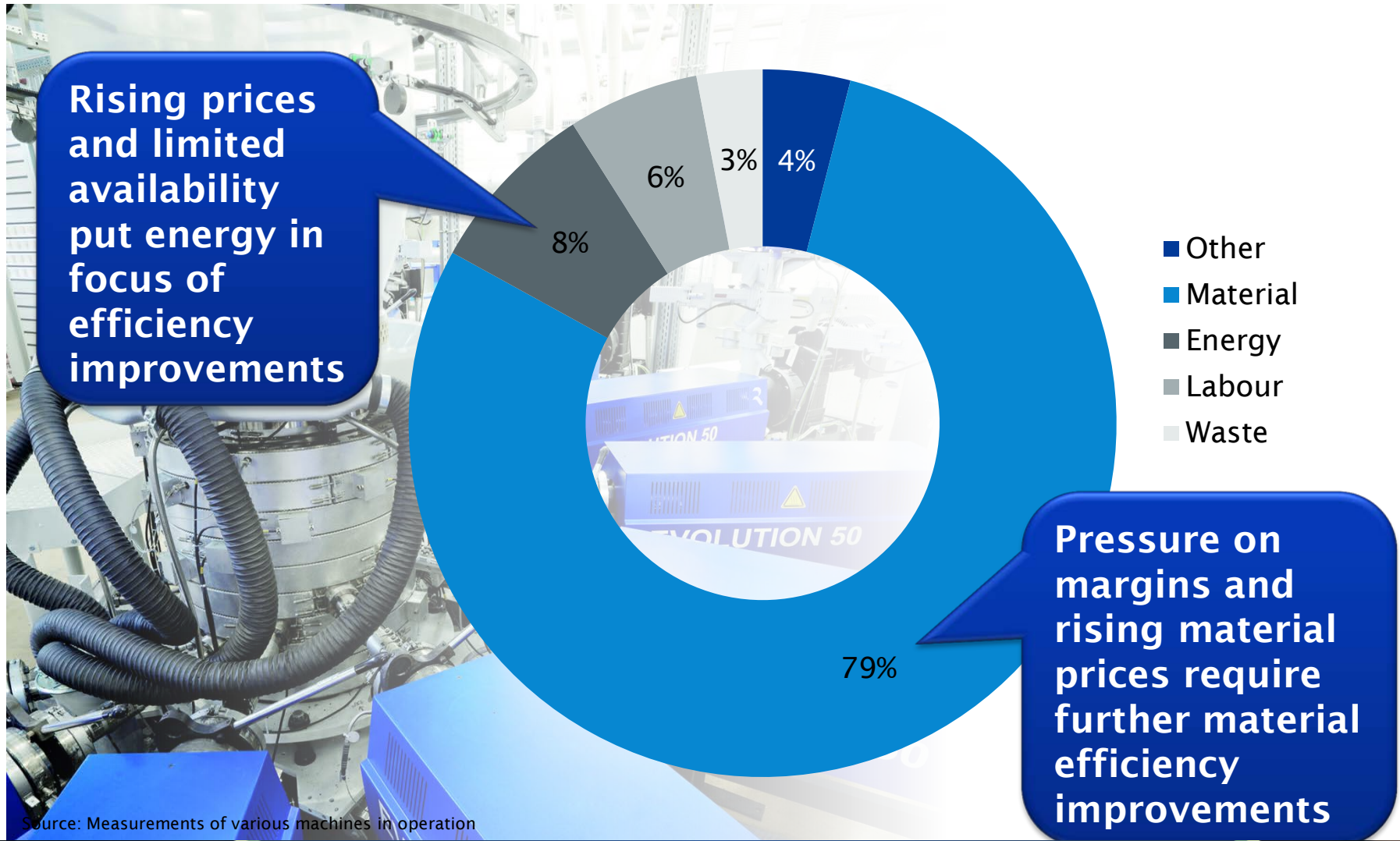
Efficient Machinery for Sustainable Film Production



BLUECOMPETENCE
Alliance Member

Partner of the Engineering Industry
Sustainability Initiative

Average Flexible Film Production Cost Breakdown





Blue Extrusion means Efficient Machinery for Sustainable Film Production



Energy-efficient blown film production

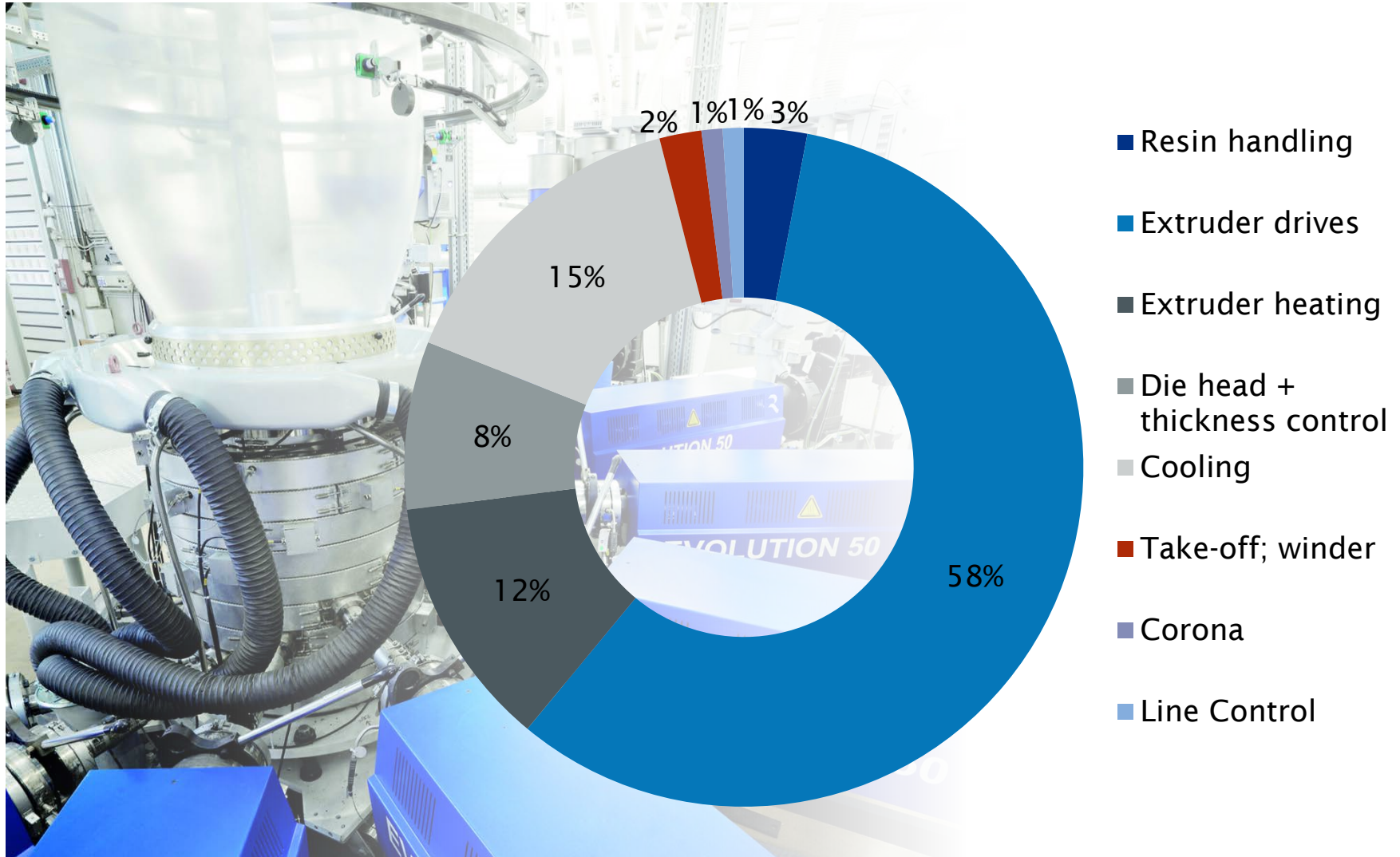
- Specific load
0.28 - 0.35 kWh/kg
- Important production values – e. g. specific load – on overview page of control panel

Screenshot from EVOLUTION control panel





Energy Consumption of a Multi-layer Blown Film Line



Source: Measurements of various machines in operation

Blue Extrusion

Efficient Machinery for Sustainable Film Production

Sustainable Blown Film Production

- Reduced energy consumption
- Reduction of waste
- Fast start-up and quick job changes
- Accurate and low film tolerances
- Downgauging
- Highest possible converting speeds
- Production of “BIO” polymers
- Educate end users 3R’s (Reduce, Recycle and Re-use)

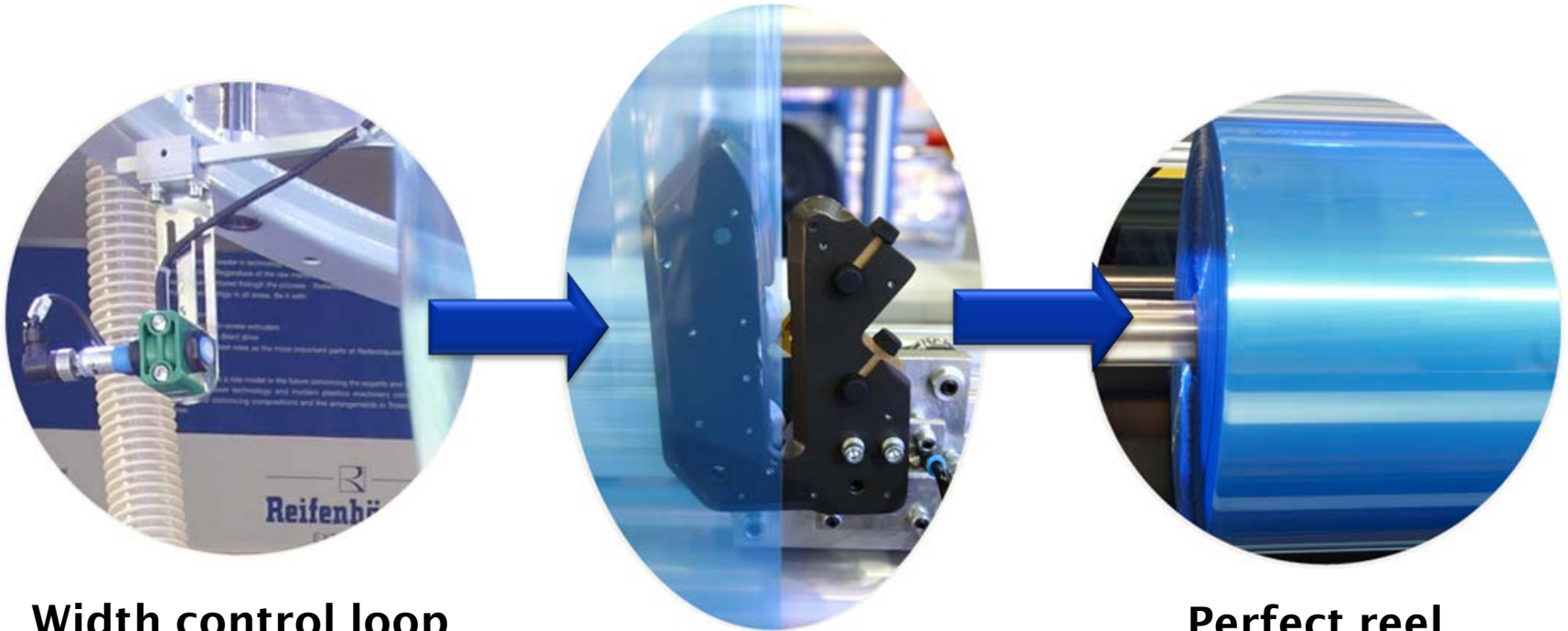
**Reduction of
carbon footprint**

**Reduction of
production costs**



“Imagine if you could reduce trim waste.”

Width Control – Waste Free Production



Width control loop

**Optimized
slitting knives**

**Perfect reel
geometry without
edge trim**



Width Control – Waste Free Production



Example of film production

Workdays / year	300
Hours / day	24
OEE	92%
Line output	1100 lb/h
Required film width	67"

Production with edge trims

Edge trim	2 × 1.0"
Gross film width	69"

Production without edge trims

Edge trim	0"
Gross film width	67.5"

2 × 0.25" extra film width for tube tolerances

Calculation of edge trim waste

$$300 \text{ d/y} \times 24 \text{ h/d} \times 92\% \times 1100 \text{ lb/h} \times (69'' - 67.5'')/69'' = 158,400 \text{ lb/year}$$

Calculation of resin cost savings

$$158,400 \text{ lb} \times \$1.07/\text{lb} \approx \$169,488$$

**Saving approx. 158,400 lb
edge trim waste / year**

**Saving approx. \$170,000/ year
+ saving handling costs for edge trims**

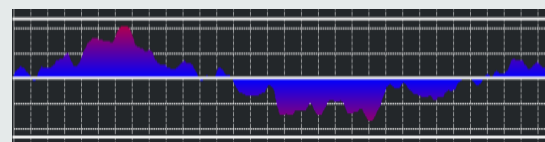
High Efficiency Profile Control



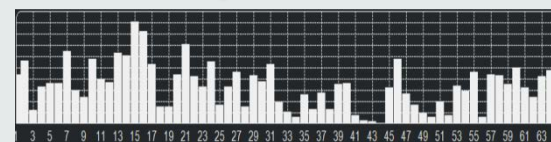
High-precision capacitive or
radiometric thickness measurement



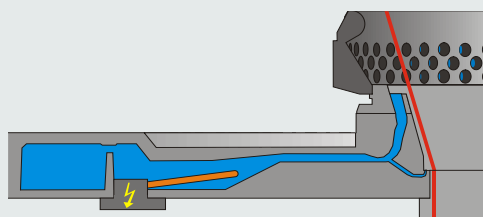
Intelligent and fast profile control



Original profile



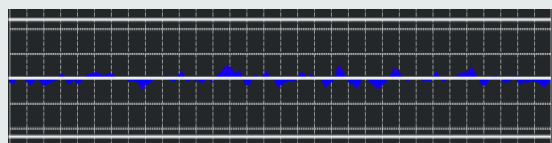
Actuators



C2 Gauge control



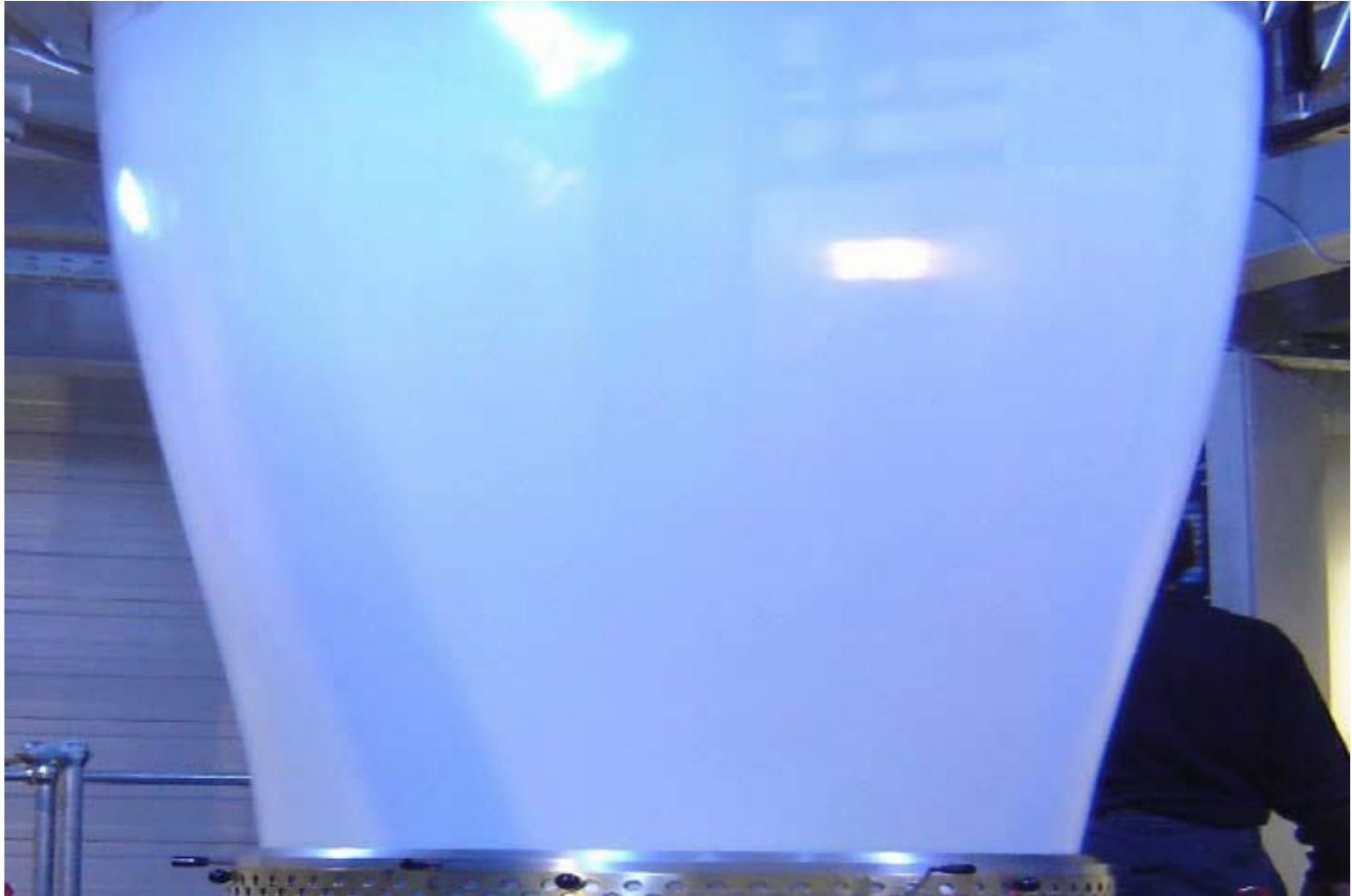
Improved thickness profile



Controlled profile



High Efficiency Profile Control





High Efficiency Profile Control

Example of film production

Workdays / year	300
Hours / day	24
OEE	92 %
Line output	1100 lb/h
Required film width	67"

Production without profile control

Profile tolerance	$\pm 7 \% 2\sigma$
-------------------	--------------------

Production with profile control

Profile tolerance	$\pm 3 \% 2\sigma$
Improvement	$\pm 4 \% 2\sigma$

Average thickness without profile control

$$2.0 \text{ mil} / (1 - 0.07) = 2.15 \text{ mil}$$

Average thickness with profile control

$$2.0 \text{ mil} / (1 - 0.03) = 2.06 \text{ mil}$$

Calculation of resin saving

$$300 \text{ d/y} \times 24 \text{ h/d} \times 92 \% \times 1100 \text{ lb/h} \times (1 - 2.06 \text{ mil} / 2.15 \text{ mil}) = 305,015 \text{ lb/year}$$

Calculation of saving resin costs

$$305,015 \text{ lb/y} \times \$1.07/\text{lb} \approx \$326,366$$

**Saving approx.
305,015 lb / year material**

Saving approx. \$327,000/ year



Start-up Assistant



- ✓ Fast start-up by use of pre-defined sequences
- ✓ Logical, gradual and easy breakdown of start-up steps
- ✓ Reduction of start-up waste
- ✓ Film producer can apply own pre-set parameters based on practical product experience



Start-up Assistant



Example of film production

Workdays / year	300
New starts / week	2
Average line output	1100 kg/h

Without Start-up Assistant

Start-up time	30 min
---------------	--------

With Start-up Assistant

Start-up time	15 min
---------------	--------

Calculation of resin savings

$$300 \text{ d/y} \times (2 / 7) / \text{d} \times (30-15) \text{ min} / 60 \text{ min/h} \times 1100 \text{ lb/h} = 23,570 \text{ lb/year}$$

Calculation of resin cost savings

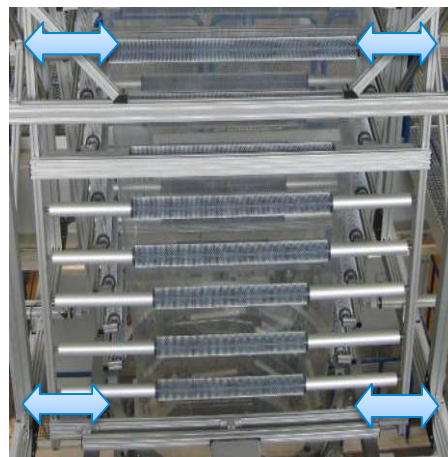
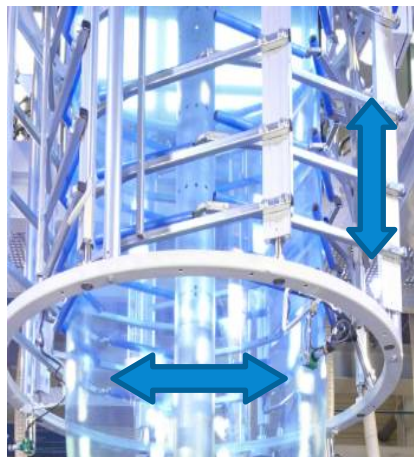
$$23,570 \text{ lb} \times \$1.07/\text{lb} \approx \$25,220$$

**Saving approx.
23,570 lb resin / year**

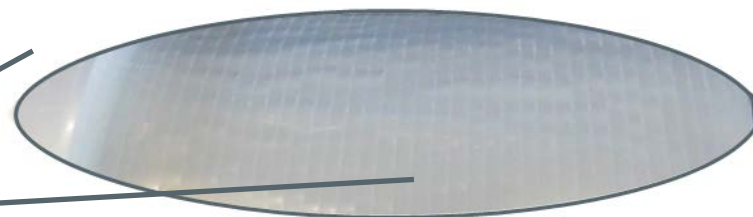
**Saving approx. \$25,000 / year
+ higher productivity of 21.4 h/y**



Job Change Assistant



- ✓ Secure product change without operator errors
- ✓ Faster than operators can manually do
- ✓ Parallel actions
- ✓ Less scrap, less costs, more profitable production
- ✓ Higher line availability for production



Job Change Assistant



Example of film production

Workdays / year	300
Changeovers / day	2
Average line output	1100lb/h

Without Job Change Assistant

Changeover time	14 min
-----------------	--------

With Job Change Assistant

Changeover time	4 min
-----------------	-------

Calculation of resin savings

$$300 \text{ d/y} \times 2 \text{ /d} \times (14-4) \text{ min} / 60 \text{ min/h} \times 1100 \text{ lb/h} = 110,000 \text{ lb/year}$$

Calculation of resin cost savings

$$110,000 \times \$1.07/\text{lb} \approx \$117,700$$

**Saving approx.
110,000 lb resin / year**

**Saving approx. \$118,000 / year
+ higher productivity of 100 h/y**



**Impact 3:
Sophistication of flexible
packaging will lead to
smarter packaging and
advanced machine technology**

Market Trends – Key Developments



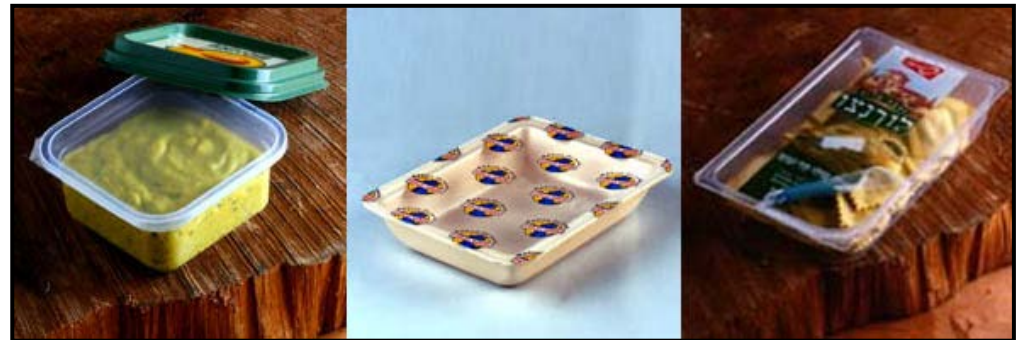
➤ Current Key Developments

- High barrier transparent films
- Biodegradable films
- Light weighting
- Easy open features in films
- Peel & recloseable lidding films



➤ Future trends in food and beverage packaging will include

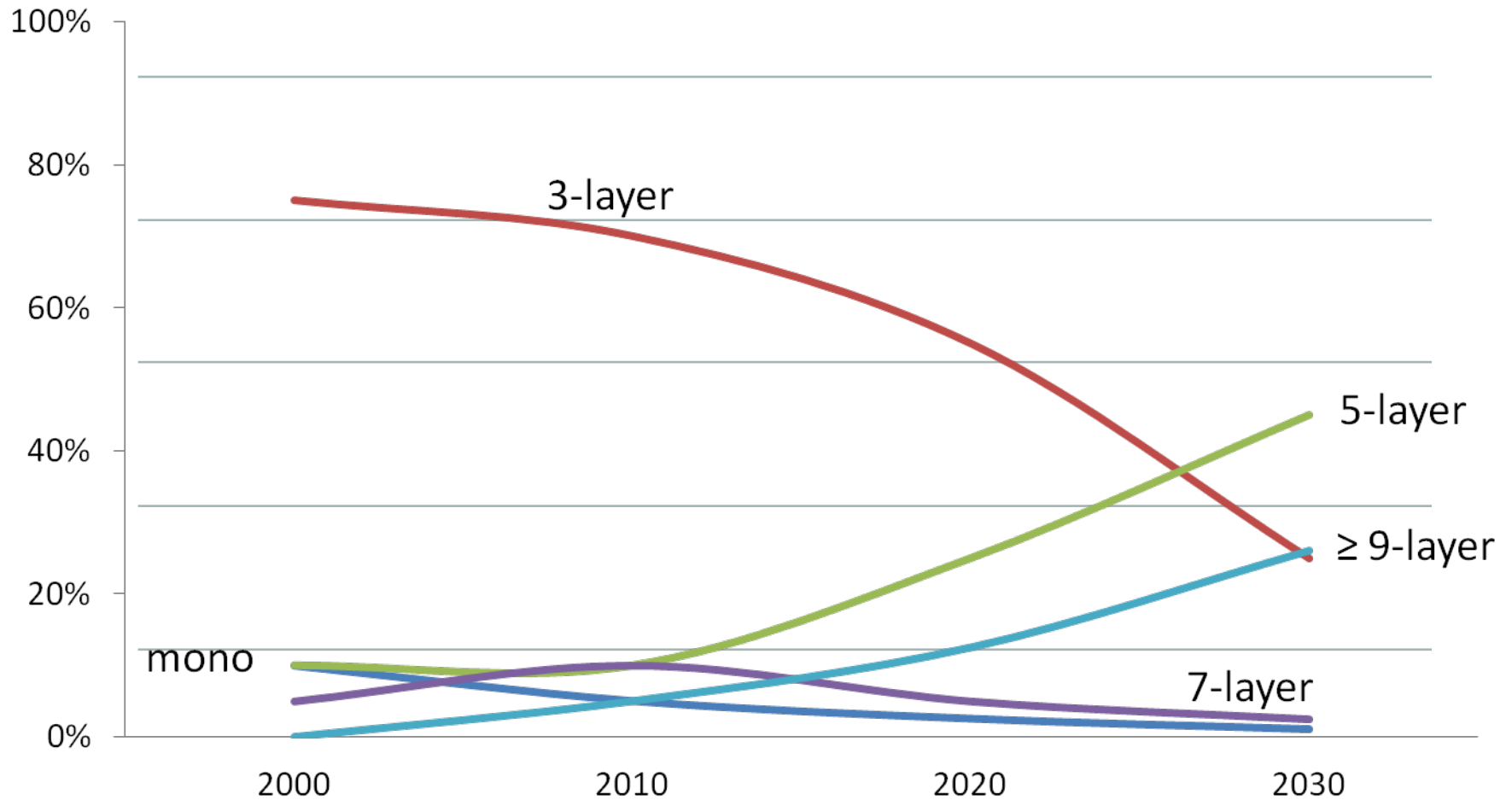
- Improved safety
- Additional functionality
- Added convenience





Multilayer Blown Film Lines Trend

Long-term Development Outlook

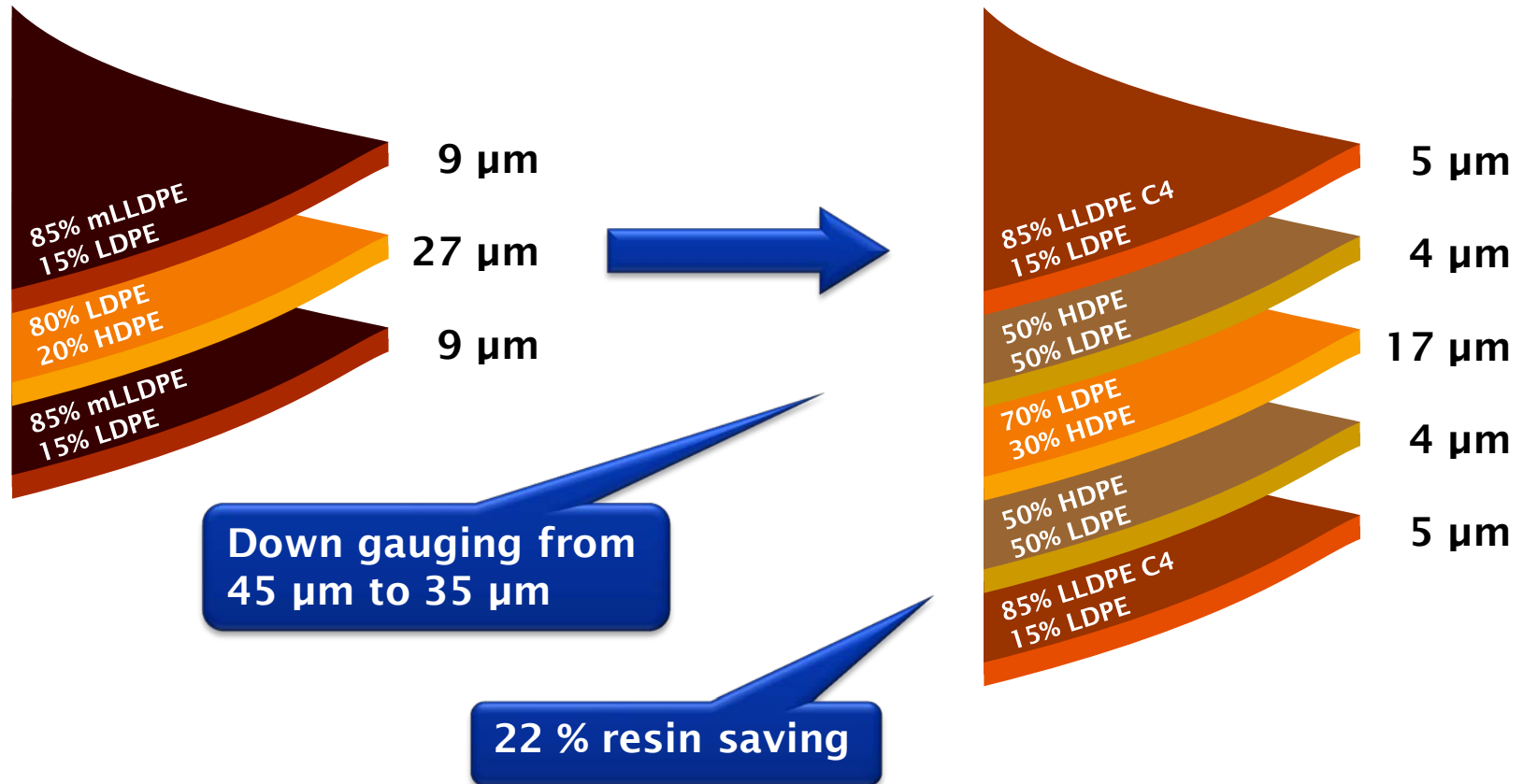


Benefits of a 5-layer Blown Film Line

Example: Down Gauging of Collation Shrink Film



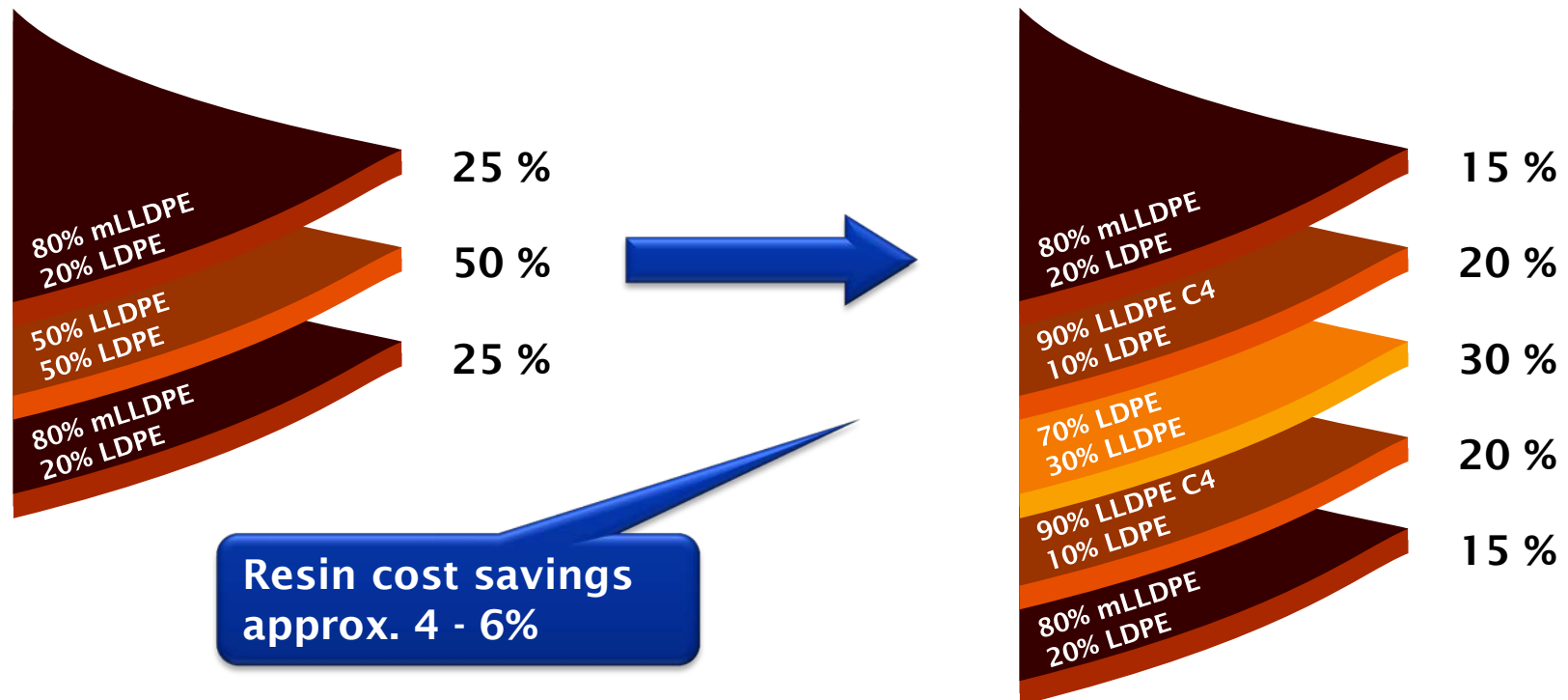
Re-arranging of layers and decreased outer layers allows to reduce the film thickness



Benefits of 5-layer Example: Cost reduction through use of cheaper resins



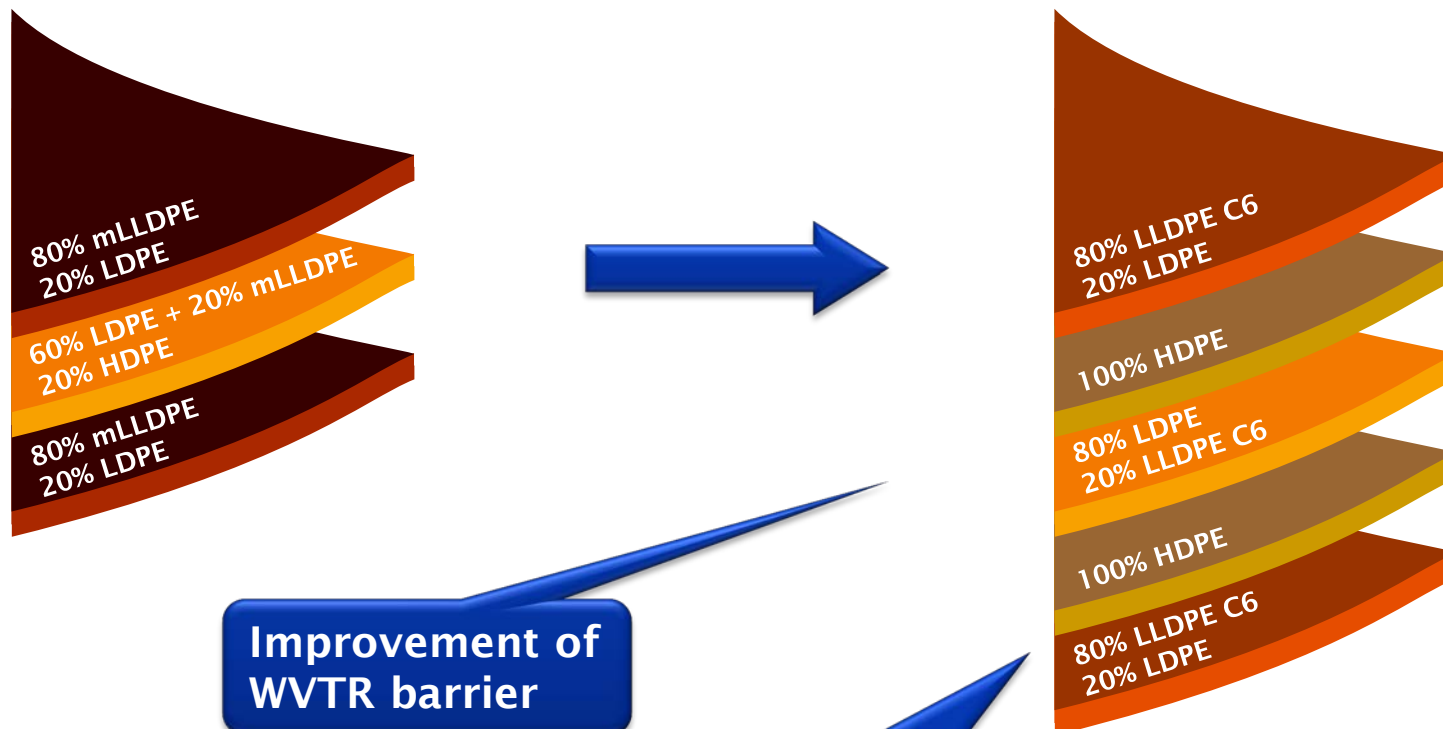
Decreased thickness of outer layers allows cost reduction due to use of standard polymers in layers B and D



Case study of

Benefits of a 5-layer Blown Film Line

Example: Improved Film Properties



Case study of

