Energy Efficiency: Plastics and Rubber Machines Well Placed!

Summary of the Study
Energy Efficiency: Plastics and Rubber Machines Well Placed

It is the EU Commission’s declared objective to cut European energy consumption by 20 per cent by 2020. This target is endorsed by Europe’s plastics and rubber machinery manufacturers – and it is achievable. This is the conclusion drawn by this EUROMAP study. The suppliers of technology at any rate have the technical ability and the will to do it!

This considerable saving can be made despite the fact that around one third of energy consumption is a constant over which we have no control, since it is the energy required to melt plastics.

The study draws attention to technological developments in energy efficiency, especially in the fields of blow moulding, extrusion, injection moulding and thermoforming. Its findings are based on an extensive survey of European plastics and rubber machinery manufacturers and processing companies. It discusses current reference studies and makes use of relevant statistics.

Starting from these facts, the study shows that it will be possible to cut machine-related energy consumption by 20 per cent by 2020. Most of this saving will come from making greater use of energy-efficient technology combined with new drive designs, further increases in the productivity of plant and manufacturing processes, and from integrating multistage processes into new operations.

The complete version of the study is available at www.euromap-wmd.info

Bernhard Merki
President

Thorsten Kühmann
Secretary General

October 2011
Position of the European Plastics and Rubber Machinery Industry Regarding Energy Efficiency

- Full commitment to the political goal of reducing energy consumption.
- Recognition of energy-saving technology as a major competitive factor on a global scale.
- Awareness of energy saving as important for both the economy and society as a whole.
- Objective of leading the world in energy-saving technology.
EUROMAP Energy Study – Main Findings

- Annual plastics consumption of Europe’s plastics converting industry totals 48.5 m tonnes

- Overall energy consumption of converters’ sites in Europe amounts to some 66.5 TWh (infrastructure building + product specific energy + machine specific energy).

- Machine-specific energy consumption in Europe totals 22.8 TWh

- One third of the machine-specific energy consumption is a constant which is required for the process of melting plastics (enthalpy). This energy input cannot be reduced due to physical reasons.

- European plastics and rubber machinery manufacturers are well placed to cut machine-specific energy consumption by around 20 per cent by 2020. The speed of energy reduction depends on the replacement of old machinery.
Plastics Consumption in Europe by Technologies (2008)

- **Injection moulding**: 13.4 Mio. t (27.6%)
- **Extrusion**: 23.3 Mio. t (48.1%)
- **Compounding**: 4.0 Mio. t (8.3%)
- **PET stretch blow moulding**: 4.0 Mio. t (8.3%)
- **Blow Moulding**: 3.1 Mio. t (6.3%)
- **Thermoforming**: 3.4 Mio. t (7.0%)
- **Other**: 4.7 Mio. t (9.7%)

Source: Plastics Europe, EUROMAP, Interviews machine and raw material manufacturers, UIC calculations
How to Determine Current Energy Consumption

- Clear definitions of specific energy consumption (SEC) have been established and provide a reliable basis for measuring energy consumption

- **M-SEC** – Machine-specific energy consumption: Heat input in terms of material, machine movements (screw, clamp, ejector, etc.)

- **P-SEC** – Product-specific energy consumption: total energy required to produce a particular finished good

- **S-SEC** – Site-specific energy consumption: any energy-related activity of a production site
Overview: Breakdown of Energy Consumption within Converting Companies (2008)

SEC [kWh/kg]

- Infrastructure, Building: 1.41 kWh/kg
- S-SEC: 0.48 kWh/kg
- P-SEC: 0.17 kWh/kg
- M-SEC: 0.17 kWh/kg
- Average enthalpy: 0.48 kWh/kg
Breakdown of Energy Consumption by Technology (2008)

**M-SEC [kWh/kg]** | **S-SEC [kWh/kg]**
--- | ---
**M-EC [TWh]** | **S-EC [TWh]**

[Diagram showing breakdown of energy consumption by technology with values for M-SEC and S-SEC for different processes.]

* For calculation purpose the specific energy consumption for PET stretch blow moulding machines is fixed with 0,3 kWh/kg (assumption)

** Assumptions: single station machines (1/3), sheet lines (2/3), ø M-SEC single station: 0,51 kWh/kg, ø M-SEC sheet lines: 0,4 kWh/kg

Rubber: 1 Mio. t consumption for technical parts, estimated M-SEC ~ 1 kWh/kg, no reliable data on S-SECs

As a comparison: the total electric energy consumption of the European industry (EU27) in year 2008 had a value of 1.135 TWh. Plastics machines (IMM, EXT, BMM, TFM) thus would account for 2,0% of industrial electric power consumption.
<table>
<thead>
<tr>
<th>Example</th>
<th>Injection Moulding (electric machine)</th>
<th>Extrusion (PVC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>O-Ring (synthetic rubber)</td>
<td>19,4 %</td>
<td>7,5 %</td>
</tr>
<tr>
<td>Closure (HDPE)</td>
<td>7,5 %</td>
<td>72,5 %</td>
</tr>
<tr>
<td>Depreciation, interest</td>
<td>41,2 %</td>
<td>1,9 %</td>
</tr>
<tr>
<td>Material costs</td>
<td>13,7 %</td>
<td>57,7 %</td>
</tr>
<tr>
<td>Scrap</td>
<td>14,0 %</td>
<td>5,0 %</td>
</tr>
<tr>
<td>Energy costs per final product</td>
<td>4,1 %</td>
<td>2,3 %</td>
</tr>
<tr>
<td>Manpower</td>
<td>7,9 %</td>
<td>16,6 %</td>
</tr>
<tr>
<td>Other costs (preproduction costs, water, auxiliary material, maintenance)</td>
<td>14,0 %</td>
<td>8,0 %</td>
</tr>
</tbody>
</table>
### Investment Behaviour - Awareness of the Energy Consumption Factor

<table>
<thead>
<tr>
<th>Processing Technology</th>
<th>Converters</th>
<th>Manufacturers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Injection moulding</td>
<td>• Energy is not in the foreground when investment decision are taken but increasing awareness.</td>
<td>• Efficient machinery and know how is available.</td>
</tr>
<tr>
<td>Extrusion</td>
<td>• Low awareness and knowledge about product specific energy consumption.</td>
<td>• Low motivation for energy efficiency due to customer behavior.</td>
</tr>
<tr>
<td>Blow moulding</td>
<td>• Converters are highly interested in energy efficiency, they ask for efficient machinery.</td>
<td>• Efficient machinery and know how is available.</td>
</tr>
<tr>
<td>Thermoforming</td>
<td>• Low knowledge and awareness level regarding energy efficiency.</td>
<td>• Efficient equipment is available but not always sold (low batch production).</td>
</tr>
</tbody>
</table>
Technology Shifts: Example Injection Moulding

Technology (share)

Efficiency development in %

- **Constant pump**: 100%
- **Hydraulic variable displacement pump**: 168%
- **Electric variable displacement pump**: 77%
- **Hydraulic pump with variable motor**: 52%
- **Electric machine**: 36%

1990 2000 2010 2020

Time

www.euromap.org
Energy Reduction due to Technology Shifts: Example Injection Moulding

Efficiency gain of whole population

- 1990
- 2000
- 2010
- 2020

CP

E-VDP

H-VDP

HP+VM

ElecM

100%

100% 77%

-23%

M-SEC machine population 2010

M-SEC machine population 2020
The Study – Procedure/Partners

- Study based on the structure of an official EU pre-study
- Market data and overview
- State-of-the-art technology
- Review of energy-related studies
- Interviews with European machinery manufacturers and converters

- Study carried out by Dr. Urbanek Technology Management GmbH, Ried, Austria

- Critical review by scientific partners
  
  Prof. Dr.-Ing. Johannes Wortberg and his team, IPE in Duisburg Institute of Product Engineering, Engineering Design and Plastics
  
  Prof. Fabio Previdi, Università degli Studi di Bergamo
  
  Prof. Sergio M. Savaresi, Politecnico di Milano