

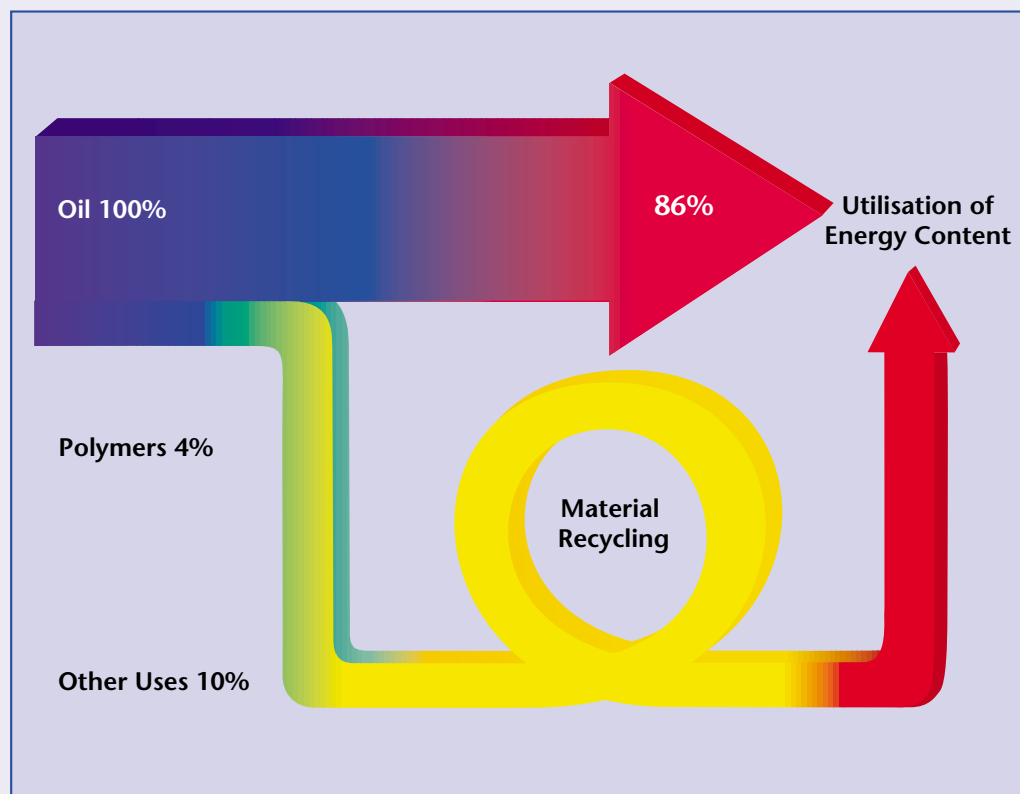
# Fact Sheet

## RECYCLING AND RECOVERING POLYURETHANES

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## Energy Recovery

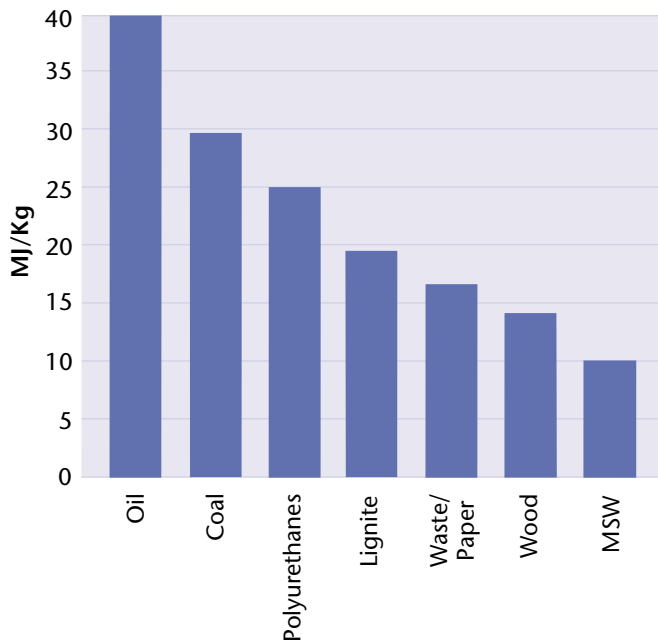


*Oil usage in West Europe*

Incineration with energy recovery has an important role to play, viewed within the context of the growing range of recycling and re-use options for plastics, including polyurethanes. With 86% of the world's oil, coal and gas being burnt for energy, there is a strong case for partial substitution of the energy resources with waste plastics. Where it is identified as the most appropriate waste management option, modern technology can now ensure that the emissions from waste combustion plants are safely managed.

Plastics account for four percent of Europe's annual consumption of natural fossil fuel - oil + gas. They are, in fact, fossil fuels in another form, sometimes referred to as 'white oil'. It seems entirely logical that they should become an energy source once their useful life is over. Polyurethanes have a recoverable energy value comparable to that of coal and less than that of fuel oil.

### Heat content of various combustible materials



Incineration is a common, vital, safe and environmentally friendly industrial process, not only in power generation. Other processes involving incineration of organic materials and, in some cases, polyurethanes include:

- the use of fossil fuels to power domestic heating systems and vehicle engines
- cement kilns
- municipal solid waste incinerators (MSW), with energy recovery
- special waste incinerators (mono-combustion)

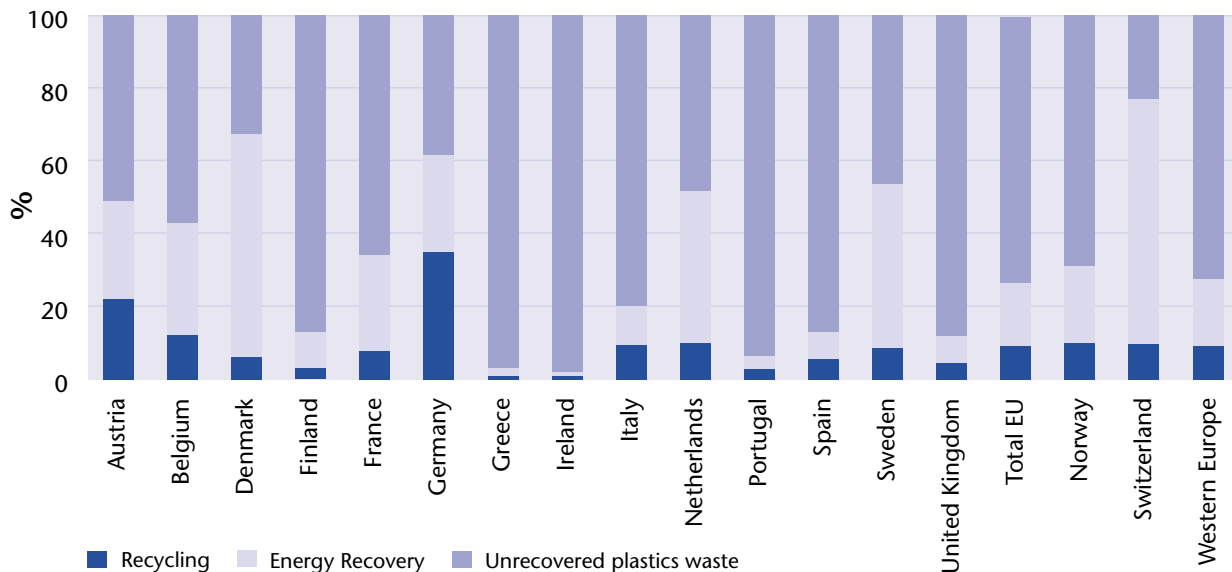
Recycling of mixed plastics waste in metallurgical applications, previously catalogued under energy recovery, is now more considered to be a feedstock recycling option using the plastics' carbon and hydrogen content as a reducing agent for the iron ore.

## ENERGY RECOVERY IN EUROPE

Public concern about the environmental impact of incineration is primarily linked to the technology used in the early waste incinerators. Modern state-of-the-art waste incinerators now have greatly reduced emissions due to efficient and effective computer controlled

raw-gas treatment facilities and process control. Despite the strict emission controls imposed on all these incineration processes, the social acceptability still varies considerably throughout Europe.

### Recycling and energy recovery breakdown by country, Western Europe 1998



Source: TN SOFRES Consulting for APME

Comparing the emissions created by various 'processes' highlights that energy recovery from burning the one kilogramme of waste generated daily by the average Western European, would create emissions equivalent to those produced by a one kilometre car journey. Even so, according to the public opinion, waste incineration today is still less socially acceptable than the burning of fossil fuel for heating or for running a car.

However, due to industry efforts, openness and information sessions, the trend is turning increasingly in favour of waste incineration with energy recovery and some countries such as Denmark or Switzerland are far ahead when it comes to using energy from waste.

### Energy from waste: European trends

Country	1996 Incineration (EFW) <sup>1</sup> (% MSW)	1998 Incineration (EFW) <sup>1</sup> (% MSW)
Switzerland	80	84
Denmark	70	80
Netherlands	40	48
France	40	50
UK	8	12
Europe (Average)	20	26

1) EFW: Energy from waste  
Source: TN SOFRES Consulting for APME

## INCINERATION WITH ENERGY RECOVERY

Polyurethanes can be incinerated safely. Incineration in MSW or other state-of-the-art combustors is, therefore, a viable treatment where other options for recovery and recycling have no environmental benefits or are ecologically or economically more costly. The plastics content of MSW helps to incinerate other components in the MSW without the need for additional fuel. Trials with an addition of 2% by weight of polyurethanes (which can be more than 30% by volume) have been carried out with flexible and rigid polyurethane foam waste with very good results. An additional advantage is that the incineration process reduces the polyurethane foam waste to 1% or less of its original volume which strongly reduces the need for landfill.

Both current and future emissions standards can also be met when polyurethanes are burnt using other combustion techniques and these are becoming available for commercial applications in co-combustion processes:

- in power stations, where polyurethanes are used as co-fuel and substitute for coal
- as co-fuel for cement kilns
- as co-fuel for industrial boilers

An added advantage of incinerating polyurethanes to recover energy is that the polyurethanes replace primary fossil fuels and thus contribute to energy conservation. Carbon dioxide emissions are hence reduced and in many cases lower emissions of SO<sub>x</sub> or NO<sub>x</sub> have been demonstrated. As for other plastics materials, there remain limits concerning the chlorine content in the waste burnt in most of these processes.

More detailed information on these combustion processes is provided in two ISOPA Fact Sheets:

- 'Recovery of Rigid Polyurethane Foam from Demolition Waste'
- 'Energy Recovery from Flexible PU Foams'

## AN ENVIRONMENTALLY RESPONSIBLE SOLUTION

Incineration with energy recovery in state-of-the-art combustors is a realistic and environmentally responsible solution for all types of polyurethanes foam waste. It offers the most valuable solution where other recovery options don't show environmental benefits and are economically more costly.

Successful energy recovery schemes will largely depend on the economics of the collection system with facilities for separation and pre-treatment of the mixed plastics waste. Based on an effective logistics framework, energy recovery can become the most cost-effective recovery option. Although more needs to be done to establish the infrastructure throughout Europe, there is no doubt that incineration with energy recovery is key to the proper management of plastic waste - including polyurethanes.

The relative cost of the various energy recovery options to society is similar for mono-combustion or for the use as co-fuel for cement kilns but here the cost of collection, sorting, pre-treatment and transport might add considerably to the overall cost. The energy recovery option with the overall lowest cost is most likely the incineration of mixed waste plastics and polyurethane waste in MSW combustors provided energy recovery and electricity generation schemes are in place.

ISOPA members have consistently supported and encouraged the study of all aspects of polyurethane incineration with energy recovery. This work will continue to provide valuable information to help management solutions for the full range of polyurethane products.

## SUGGESTED READING

"The influence of plastics on the combustion of municipal solid waste"; TNO Institute of Environmental and Energy Technology, 7300 AH Apeldoorn, The Netherlands.

"Waste to energy", brochure, PWMI European Centre for Plastics in the Environment, Avenue E van Nieuwenhuysse 4, Box 5, 1160 - Brussels, Belgium.

"PDF as a source of energy"; M. Frankenhauser, Neste OY, Finland, 1992

"Shredderleichtmull aus der Sicht der Entsorgungsindustrie"; IUTA-Workshop 'Entsorgung von Schredderleichtmull', Duisburg, am 7.9.1990

"Schwel-Brenn-Verfahren zur thermischen Behandlung der Shredderleichtfraktion"; Bayer-Vortrag im Rahmen der VWI-VW-Gemeinschaftstagung; Wolfsburg; 26-28 November 1991.

"Large scale energy recovery trials on polyurethane, PET, acrylic and nylon"; Dr. DJ Soderberg, RA Lenton, AR Boylett and DA Hicks.

"Energy recovery in industrial boilers -a new approach for post consumer polyurethane foam from car seats"; E. Weigand, J. Wagner and G. Waltenberger, Bayer Leverkusen.

"Fluidised Bed Incineration of Automobile Shredder Residue"; R.S. Taberny, K. Dangtran, National Meeting of the Institute of Scrap Recycling Industries, New Orleans, 9-14 March 1990.

"Developing a Viable Polyurethane Waste Management Plan; a PURRC Update"; G.J. Wasilczyk and T.J. Cerabona; SPI Polyurethanes Congress, Vancouver, 1993

"TNO report", 1992, TNO Apeldoorn, NL Survey of Solid Municipal Waste Incinerators. Available through APME.

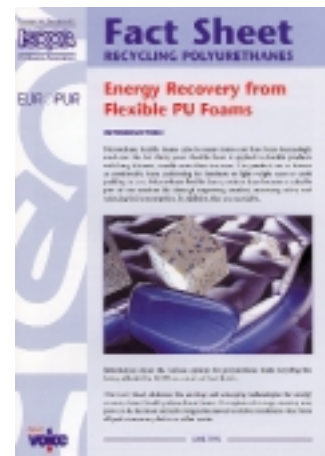
"Verbrennen von Polyurethanen"; K.W. Kroesen in Recycling von Polyurethanen; W. Rasshofer ISBN 3-929471-08-6.

"Information System on Plastic Waste Management in Europe, European Overview, 1998 Data"; TN SOFRES Consulting for APME, published Jan. 2000

"Fuel substitution for cement kilns through source separated plastics packaging waste"; Frank Mark, A. Caluori, APME, Brussels 1998

"Mechanical separation of mixed plastics from household waste and energy recovery in a pulverised coal-fired power station"; L.A.A. Schöen, M.L. Beekes, J. van Tubergen, C. H. Korevaar, APME, Brussels 2000

"Fact sheet: Energy recovery from Flexible PUR foams"; ISOPA-EUROPUR, June 1996, J. Stoute, 05-96-REC.-0009-FACT SHEET.



"Fact sheet: Recovery of Rigid Polyurethane Foam from Demolition Waste"; ISOPA-BING, August 1996, K.W.Kroesen, 08-96-REC.-0011-FACT SHEET.



Recycling companies are kindly invited to submit to ISOPA their references in case they are active in practicing PU recycling and recovery.



ISOPA has produced a brochure and a series of fact sheets on polyurethane recycling options.

The following are now available :

Recycling Polyurethanes (Brochure)

PU in Perspective

Densification/Grinding

Re-use of Particles

Rebonded Flexible Foam

Adhesive Pressing/Particle Bonding

Regrind/Powdering

Compression Moulding

Chemolysis

Feedstock Recovery

Energy Recovery

Energy Recovery from Flexible PU Foams

Recovery of Rigid Polyurethane Foam from Demolition Waste

Options in Practice

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ISOPA - the European Isocyanates Producers' Association - is an affiliated organisation within the European Chemical Industry Council (CEFIC).

Since the original polyurethane material has not been designed for use in articles in contact with food, relevant EU (such as Directives 90/128/EEC) and national legislations need to be consulted, if and when recycled materials are used to manufacture articles and goods for possible direct and indirect food contact.

The information contained in this publication is, to the best of our knowledge, true and accurate, but any recommendation or suggestions which may be made are without guarantee, since the conditions of use and the composition of source materials are beyond our control. Furthermore, nothing contained herein shall be construed as a recommendation to use any product in conflict with existing patents covering any material or its use.

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