

UK oil refining and the atmospheric emission of dioxins

A briefing paper

2nd edition

UK OIL REFINING AND THE ATMOSPHERIC EMISSION OF DIOXINS
A BRIEFING PAPER

2nd edition

November 2014

Published by

ENERGY INSTITUTE, LONDON

The Energy Institute is a professional membership body incorporated by Royal Charter 2003

Registered charity number 1097899

The Energy Institute (EI) is the chartered professional membership body for the energy industry, supporting over 19 000 individuals working in or studying energy and 250 energy companies worldwide. The EI provides learning and networking opportunities to support professional development, as well as professional recognition and technical and scientific knowledge resources on energy in all its forms and applications.

The EI's purpose is to develop and disseminate knowledge, skills and good practice towards a safe, secure and sustainable energy system. In fulfilling this mission, the EI addresses the depth and breadth of the energy sector, from fuels and fuels distribution to health and safety, sustainability and the environment. It also informs policy by providing a platform for debate and scientifically-sound information on energy issues.

The EI is licensed by:

- the Engineering Council to award Chartered, Incorporated and Engineering Technician status;
- the Science Council to award Chartered Scientist status, and
- the Society for the Environment to award Chartered Environmentalist status.

It also offers its own Chartered Energy Engineer, Chartered Petroleum Engineer and Chartered Energy Manager titles.

A registered charity, the EI serves society with independence, professionalism and a wealth of expertise in all energy matters.

This publication has been produced as a result of work carried out within the Technical Team of the EI, funded by the EI's Technical Partners. The EI's Technical Work Programme provides industry with cost-effective, value-adding knowledge on key current and future issues affecting those operating in the energy sector, both in the UK and internationally.

For further information, please visit <http://www.energyinst.org>

The EI gratefully acknowledges the financial contributions towards the scientific and technical programme from the following companies

BG Group	Premier Oil
BP Exploration Operating Co Ltd	RWE npower
BP Oil UK Ltd	Saudi Aramco
Centrica	Scottish Power
Chevron	SGS
ConocoPhillips Ltd	Shell UK Oil Products Limited
Dana Petroleum	Shell U.K. Exploration and Production Ltd
DONG Energy	SSE
EDF Energy	Statkraft
ENI	Statoil
E. ON UK	Talisman Sinopec Energy UK Ltd
ExxonMobil International Ltd	Total E&P UK Limited
International Power	Total UK Limited
Kuwait Petroleum International Ltd	Tullow
Maersk Oil North Sea UK Limited	Valero
Murco Petroleum Ltd	Vattenfall
Nexen	Vitol
Phillips 66	World Fuel Services

However, it should be noted that the above organisations have not all been directly involved in the development of this publication, nor do they necessarily endorse its content.

Copyright © 2014 by the Energy Institute, London.
The Energy Institute is a professional membership body incorporated by Royal Charter 2003.
Registered charity number 1097899, England
All rights reserved

No part of this book may be reproduced by any means, or transmitted or translated into a machine language without the written permission of the publisher.

ISBN 978 0 85293 709 9

Published by the Energy Institute

The information contained in this publication is provided for general information purposes only. Whilst the Energy Institute and the contributors have applied reasonable care in developing this publication, no representations or warranties, express or implied, are made by the Energy Institute or any of the contributors concerning the applicability, suitability, accuracy or completeness of the information contained herein and the Energy Institute and the contributors accept no responsibility whatsoever for the use of this information. Neither the Energy Institute nor any of the contributors shall be liable in any way for any liability, loss, cost or damage incurred as a result of the receipt or use of the information contained herein.

Hard copy and electronic access to EI and IP publications is available via our website, www.energypublishing.org.
Documents can be purchased online as downloadable pdfs or on an annual subscription for single users and companies.
For more information, contact the EI Publications Team.
e: pubs@energyinst.org

CONTENTS

	Page
Foreword	4
Acknowledgements	5
Summary	6
1 Introduction	8
2 Chemistry	9
3 Formation	10
3.1 Conditions	10
3.2 Processes	10
3.3 Abatement	11
4 Human health effects	12
4.1 Toxic equivalence	12
4.2 Toxicity	13
4.3 Human exposure	15
4.3.1 Tolerable daily intake (TDI)	15
4.3.2 Past and present UK TDIs	16
5 UK national emissions	17
6 Regulatory climate	19
7 Refineries	21
7.1 Potential refinery sources	21
7.2 Estimates of UK refinery emissions	21
7.3 Refinery emission factors	23
8 Sampling	26
9 Conclusions	27
10 References	28
11 Glossary	30

FOREWORD

In 2004 the EI (then Institute of Petroleum) published the paper *UK oil refining and the atmospheric emission of dioxins*.

This second edition of the EI paper reviews the latest health effect data as well as the contribution of the refining industry to the UK dioxin and furan inventory. It also updates the legislative references.

ACKNOWLEDGEMENTS

The update of this report was commissioned by the Energy Institute's (EI) Emission Working Group and the work was undertaken by AMEC Environment & Infrastructure UK Limited.

The EI wishes to thank Adam Clegg, Rob Whiting and Caspar Corden as the authors of this report, and also the EI's Emissions Working Group for steering this project through to completion.

Members of the Steering Committee for this project include:

Ian N. Althorp	Exxon Mobil
Bernard Brown	Murco Petroleum Ltd.
Sarah Catmull	P66
Timothy A. Davies	Valero
Kevin Lenthall	Total
Brian Smithers	

1 INTRODUCTION

This briefing paper is not intended to be a comprehensive technical review. Rather it is a synthesis of material in the public domain, compiled to inform the non-expert. It is structured to set context first by covering topics common to all sources (potential formation pathways, adverse effects, national emissions, policy), then the focus moves to refinery specifics in section 7.

Until recently, dioxins were thought to be a problem only because of their presence as contaminants of certain industrial and agricultural chemicals. Over the last 30 years or so, there has been an enormous increase in the sensitivity of analytical techniques used to measure dioxins and these contaminants can now be detected at extremely low levels which were previously too low to measure. It is now clear that dioxins are widely distributed in the environment, albeit at exceptionally low concentrations and that they are produced not just as by-products of chemical manufacture but also as common products of combustion.