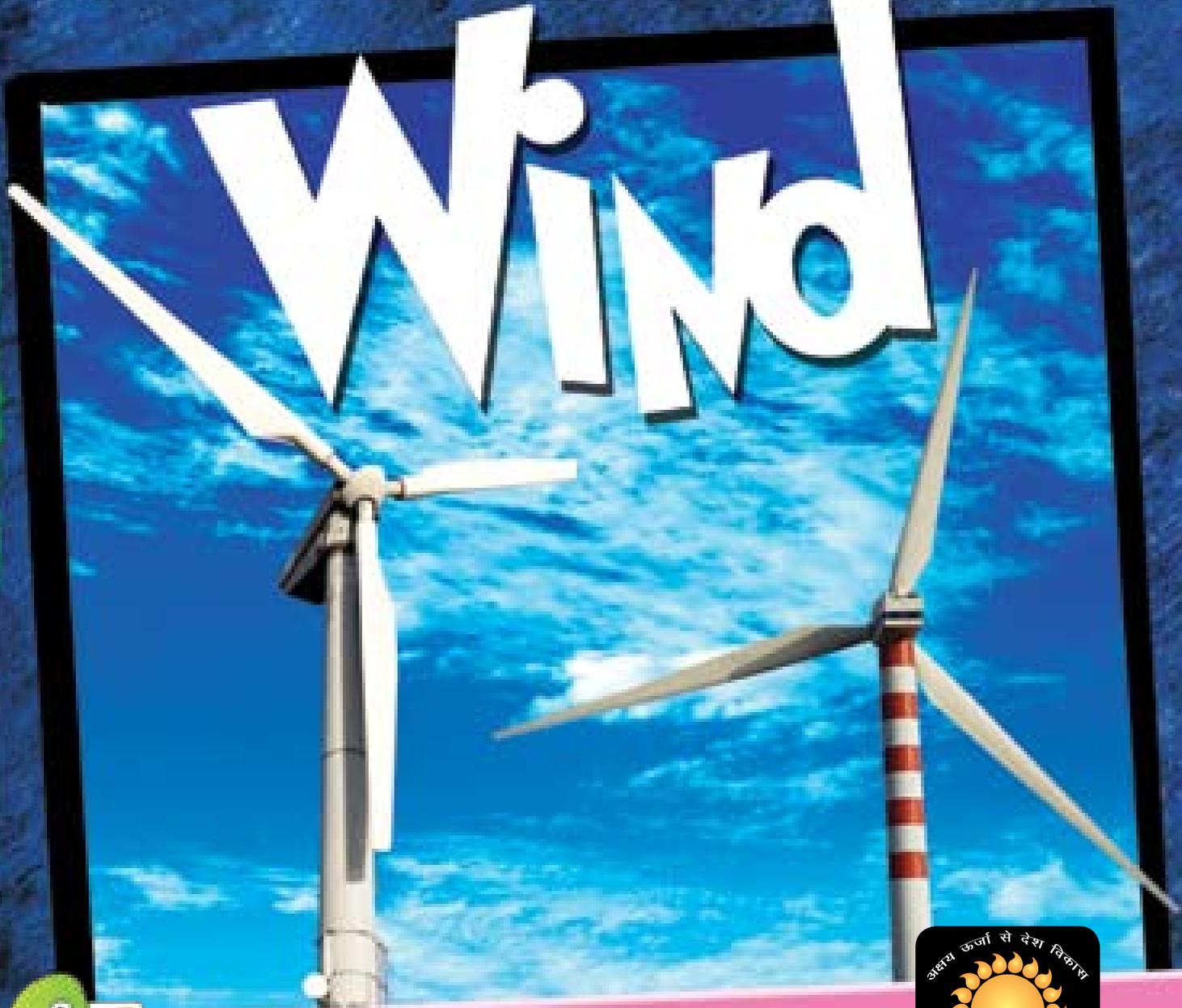


**SUPER-POWERED  
EARTH**

# **ENERGY** from the **Gust of**

# **Wind**



**WIND POWER: EVERYTHING YOU EVER WANTED  
TO KNOW ABOUT CLEAN, GREEN POWER!**



Ministry of New and Renewable Energy  
Government of India



First published in 2009 by  
**The Energy and Resources Institute and Ministry of New and Renewable Energy, Government of India**  
at TERI Press

Darbari Seth Block, IHC Complex, Lodhi Road, New Delhi - 110 003, India

Tel. 2468 2100/4150 4900, Fax: 2468 2144/2468 2145

India +91 • Delhi (0)11

E-mail: [teripress@teri.res.in](mailto:teripress@teri.res.in) • Website: <http://bookstore.teriin.org>

© The Energy and Resources Institute, 2009  
The series has been brought out with the support of Ministry of New and Renewable Energy, GoI

ISBN 978-81-7993-135-6

All rights reserved. No part of this publication may be reproduced  
in any form or by any means without the prior permission of  
The Energy and Resources Institute.

Author: Benita Sen  
Managing Editor: Madhu Singh Sirohi  
Series Editor: Pallavi Sah  
Senior Editors: Arshi Ahmed and Kirti Kaul  
Technical Review: Amit Kumar  
Creative Head: Priyabrata Roy Chowdhury  
Design: Priyabrata Roy Chowdhury, R Ajith Kumar  
Cover Design: Priyabrata Roy Chowdhury  
Production: T Radhakrishnan  
Prepress: Mahfooz Alam  
Illustrations: Sudhakar Gautam

Printed and bound in India

This book is printed on recycled paper

**SUPER-POWERED  
EARTH**

# ENERGY from the Gust of Wind



Ministry of New and Renewable Energy  
Government of India

## Message

India has witnessed healthy economic growth during the last few decades. This progress has resulted in faster consumption of our natural resources. Increasing exploitation of fossil fuels such as coal, oil and natural gas has led to various environmental problems such as global warming and climate change.

As a nation, we need to adopt a sustainable path of development, not just for our continuing economic growth, but also to protect the environment. Increased use of renewable energy sources, coupled with energy conservation, will lead to sustained supply of energy and sustainable development. The promotion of renewable energy sources in the country needs widespread publicity, so that these can be accepted and adopted by people at large.

As future citizens, children can make a major contribution in protecting the environment and natural resources. They can take the lead in organizing actions that support conservation of resources and greater use of renewable energy sources at the community level.

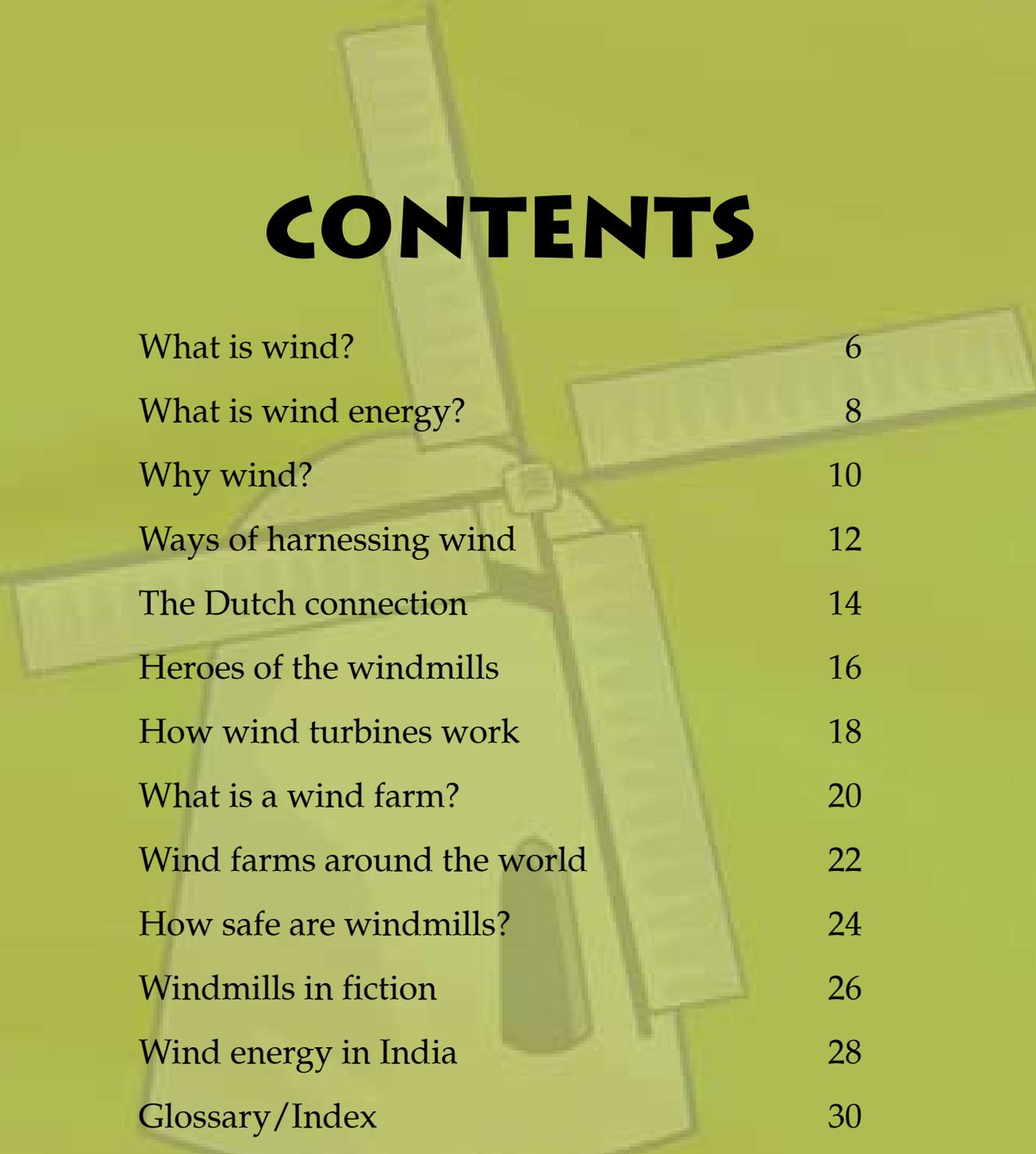
It gives us immense pleasure to put forth this series of books on renewable energy sources. We hope that children who read these books will not only enjoy them greatly, but also feel inspired to bring about a positive change, so that we leave a healthy and beautiful world for generations to come.



**R K Pachauri**  
Director-General, TERI  
Chairman  
Intergovernmental Panel on  
Climate Change



**Shri Vilas Muttemwar**  
Minister of State  
Ministry of New and Renewable Energy  
Government of India



# CONTENTS

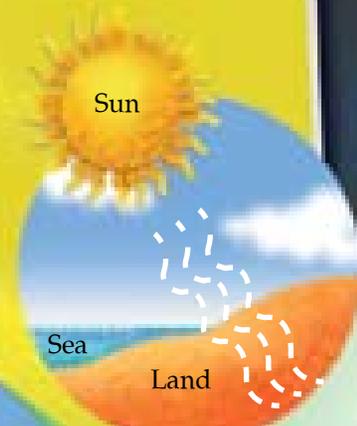
What is wind?	6
What is wind energy?	8
Why wind?	10
Ways of harnessing wind	12
The Dutch connection	14
Heroes of the windmills	16
How wind turbines work	18
What is a wind farm?	20
Wind farms around the world	22
How safe are windmills?	24
Windmills in fiction	26
Wind energy in India	28
Glossary/Index	30

# What is wind?



Have you ever blown soap bubbles into the air? The bubbles are carried away by a gust of air that you blow out. This movement of air is called wind. We cannot see, smell or taste air, but we can see it carry the bubbles away. We can feel the rush of air, and we smell what is cooking in the neighbour's kitchen because the moving air carries the aroma to us. We can know the direction and measure the speed of wind.

*Sunrays heat up the land, the air surrounding it, and the sea.*

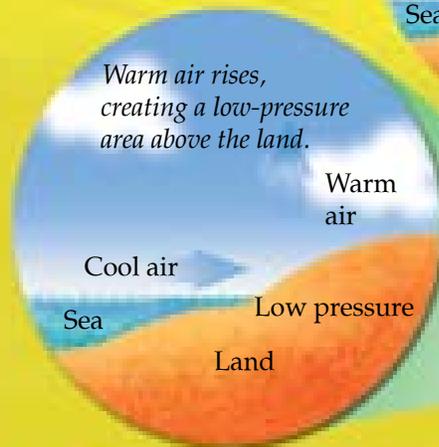


↑ *The moving air, which carries away your soap bubbles, is wind.*

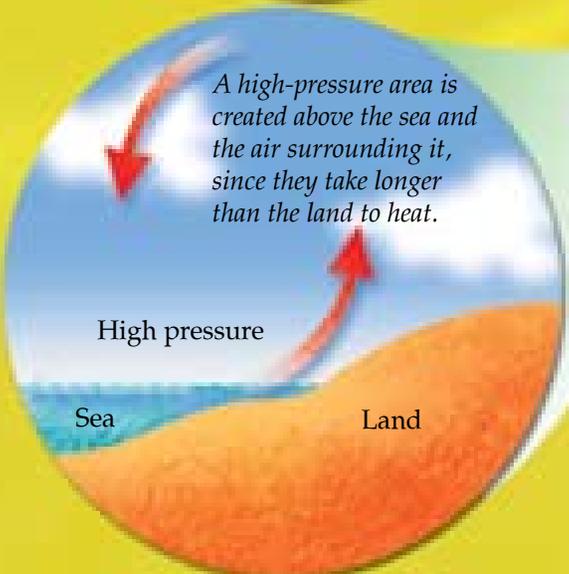
## High to low pressure

Heat from the sun warms up the land, the sea, and the nearby air. But everything does not heat up at the same time and to the same temperature. The land heats up faster than the sea and the air near the land gets warmer quicker than the air above the sea. This hot air rises and leaves behind a low-pressure area. Cool air rushes in from high-pressure areas, or places with more air, to take its place. This rush of air is wind.

Wind moves across from the equator to the poles or from the land to the sea rather than straight up from the land to the atmosphere.



*Warm air rises, creating a low-pressure area above the land.*



*A high-pressure area is created above the sea and the air surrounding it, since they take longer than the land to heat.*

## Goes on and on and on

Wind can move things. It can work! Wind energy does not have to be mined, dug or drilled out. We may run out of coal, petroleum, and other fossil fuels dug up from inside the earth, but wind energy will last as long as the sun shines. That is why wind is called a renewable source of energy. Winds are named according to the direction they blow from. A north wind blows from north to south.

*The earth spins on its axis and drags the atmosphere with it. The force of gravity works strongest on the air closest to the earth, as a result of which this layer moves more. Air that is higher in the atmosphere is stirred less. This leads to different air speeds.*

*Wind usually blows from high-pressure areas to low-pressure areas.*

Land



### Wind gods!

The wind dries wet hair, blows seeds far to help plants multiply, and propels ships over the waters. Strong winds can blow roofs and homes away. No wonder, people have worshipped the wind for thousands of years. Greeks called the wind god Aeolus and the Sumerians, Zu. Shu was the Egyptian god of wind, while Raja Angin was the Malayan king of wind. People in India call him Pavan or Vayu.

# What is wind energy?

Whether you blow an eyelash off your hand or bounce a ball, you need energy to do it. Energy is the power to do work. Wind has kinetic energy, or the energy of movement. The faster it blows, the more kinetic energy it has, and so, the more work it can get done.

## It was a gale....No, a tornado

In 1805, Sir Francis Beaufort of the British Navy created the Beaufort scale with thirteen categories, ranging from 0 to 12. In 1946, scientists found that the scale could not measure very high wind speeds and added notches 13 to 17. A 9 on the Beaufort scale means a strong gale or a Category 1 cyclone rushing in at 75–88 kilometres per hour. It can blow off tiles and chimney pots! The strongest winds are known as tornadoes. They can reach a speed of more than 480 kilometres per hour. Other scales that measure tornadoes are Fujita and Torro.

*The year 2005 witnessed the most number of hurricanes, including the fierce Hurricane Wilma, the ▼twelfth in the year.*



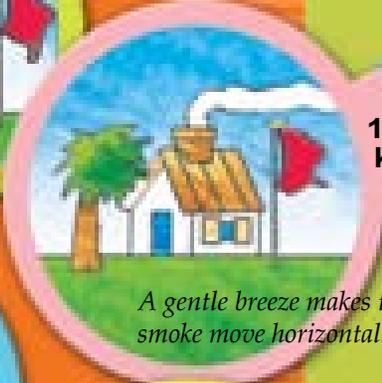
**2–5 km/h**

*Smoke moves in the direction of wind.*



**12–20 km/h**

*A gentle breeze makes the smoke move horizontally.*

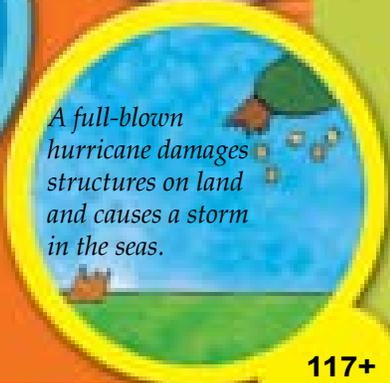


**75–88 km/h**

*A strong gale breaks branches and uproots trees.*



*A full-blown hurricane damages structures on land and causes a storm in the seas.*



**117+ km/h**

km/h: kilometres per hour

## So long, so strong!

Hurricane John in the Pacific Ocean was the longest-lasting hurricane. It lasted for thirty-one days during August to September 1994. The Rameswaram cyclone hit the southern tip of India during December 17–24, 1964. Dhanuskodi, a city on Rameswaram island, disappeared. The Pamban bridge and a train were washed away!

## That was some wind!

A gust of wind may last for only a few seconds. If this wind blew a hat off your head, it would fall a short distance away. Some gusts may be stronger and can carry the hat a little farther. The strongest gust of wind ever recorded rushed in on April 12, 1934, at a speed of 371 kilometres per hour at Mount Washington, United States. If it had lasted for even one minute and blown straight ahead, that hat could well have travelled more than six kilometres!

Some winds blow down frozen mountain sides. These are called katabatic winds. They get their names from the Greek word 'katabatikos', which means 'going downhill'. In Antarctica, they can reach 320 kilometres per hour. Brrr!

## Which way did that blow

To make wind work for you, it is important to know its direction. You can check direction by hoisting an old sock on a stick dug into a flower pot. Watch the direction the toes point to and mark according to compass points. Now you're ready to fly that kite!

# Why wind?

The earth is getting warmer because of the increasing greenhouse gases in the atmosphere. Some of these, such as carbon dioxide, methane, ozone, and nitrous oxide, are found naturally and some, like hydrofluorocarbons, perfluorocarbons, and sulphur hexafluoride, are released by machines. Burning fossil fuels such as coal and oil is mainly responsible for the emission of extra greenhouse gases.

## Let's get off fossil fuels

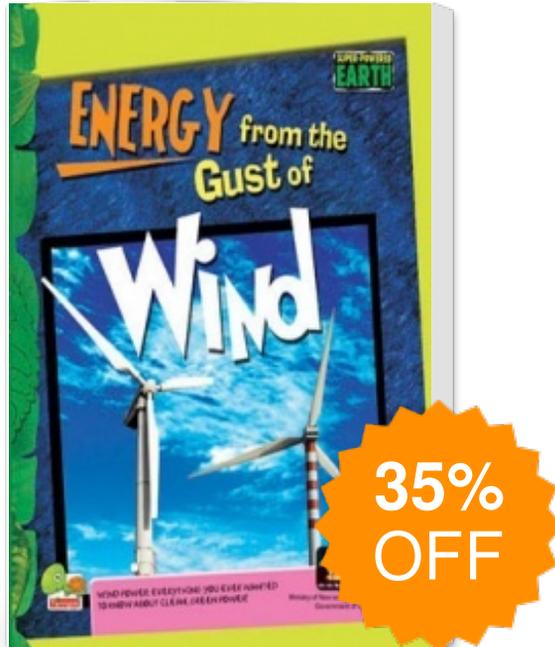
Coal, petrol, and diesel not only release harmful greenhouse gases, they also take millions of years to form. About 86 per cent of the energy we need comes from fossil fuels. Nuclear power produces about 6 per cent of energy, but it creates dangerous waste. Less than 1 per cent of energy comes from renewable sources such as the sun, tides, biomass, and wind.

## So, blow, wind, blow!

For almost a thousand years, wind energy had done different kinds of work for us. However, during the Industrial Revolution, machines that ran on fossil fuels gradually took over. These machines released a lot of greenhouse gases. Now that people are finding out the dangers of using fossil fuels, wind energy is again gaining favour as one of the safest forms of energy, and it is growing faster than any other alternative energy source.

*The Industrial Revolution less than three hundred years ago saw machines become more popular than human labour.*

# Super-Powered Earth : Energy from the Gust of Wind



Publisher : **TERI Press**

ISBN : **9788179931356**

Author : **Benita Sen**

Type the URL : <http://www.kopykitab.com/product/8458>



**Get this eBook**