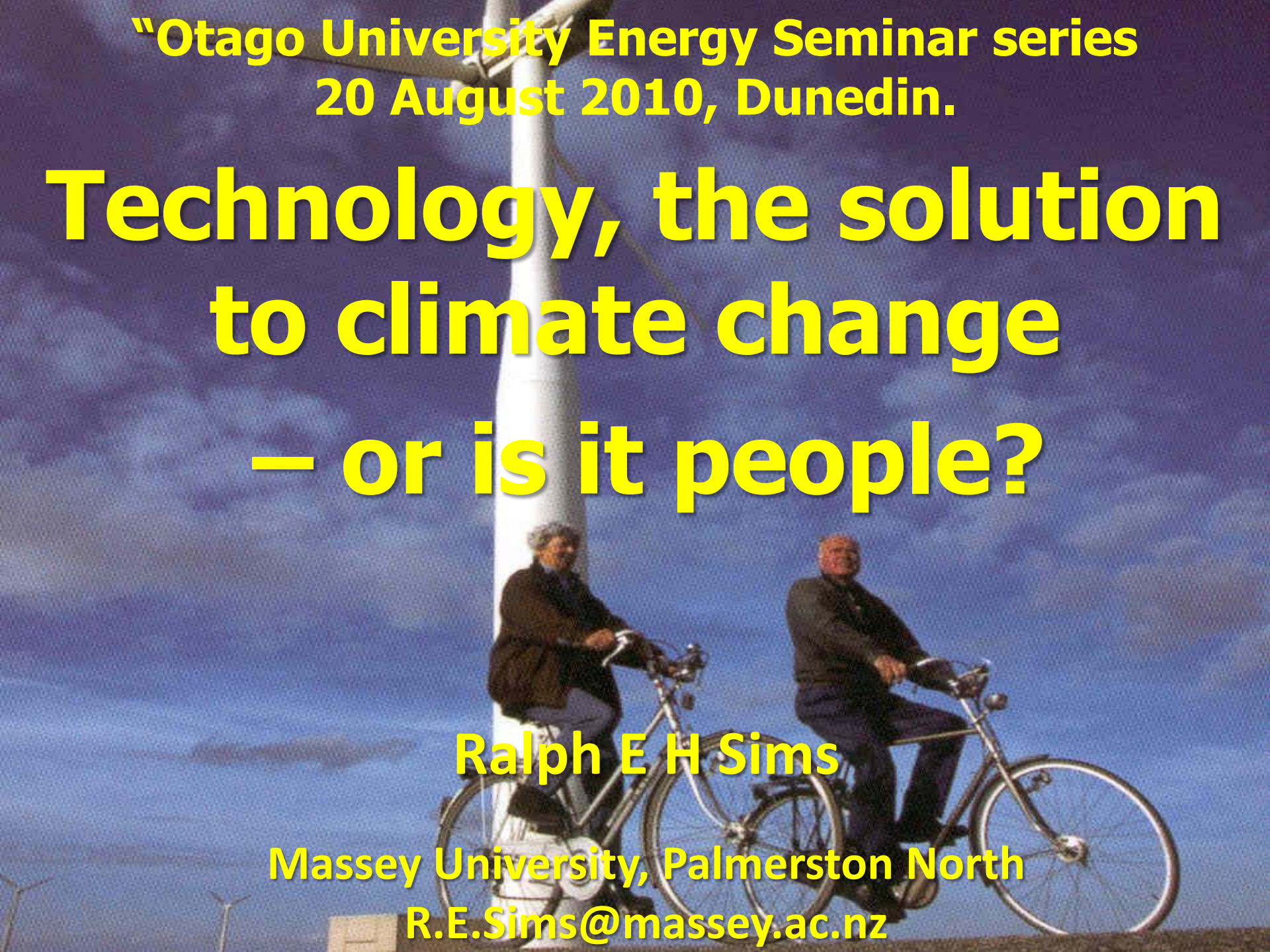


**"Otago University Energy Seminar series  
20 August 2010, Dunedin.**

# **Technology, the solution to climate change – or is it people?**

**Ralph E H Sims**

**Massey University, Palmerston North  
R.E.Sims@massey.ac.nz**

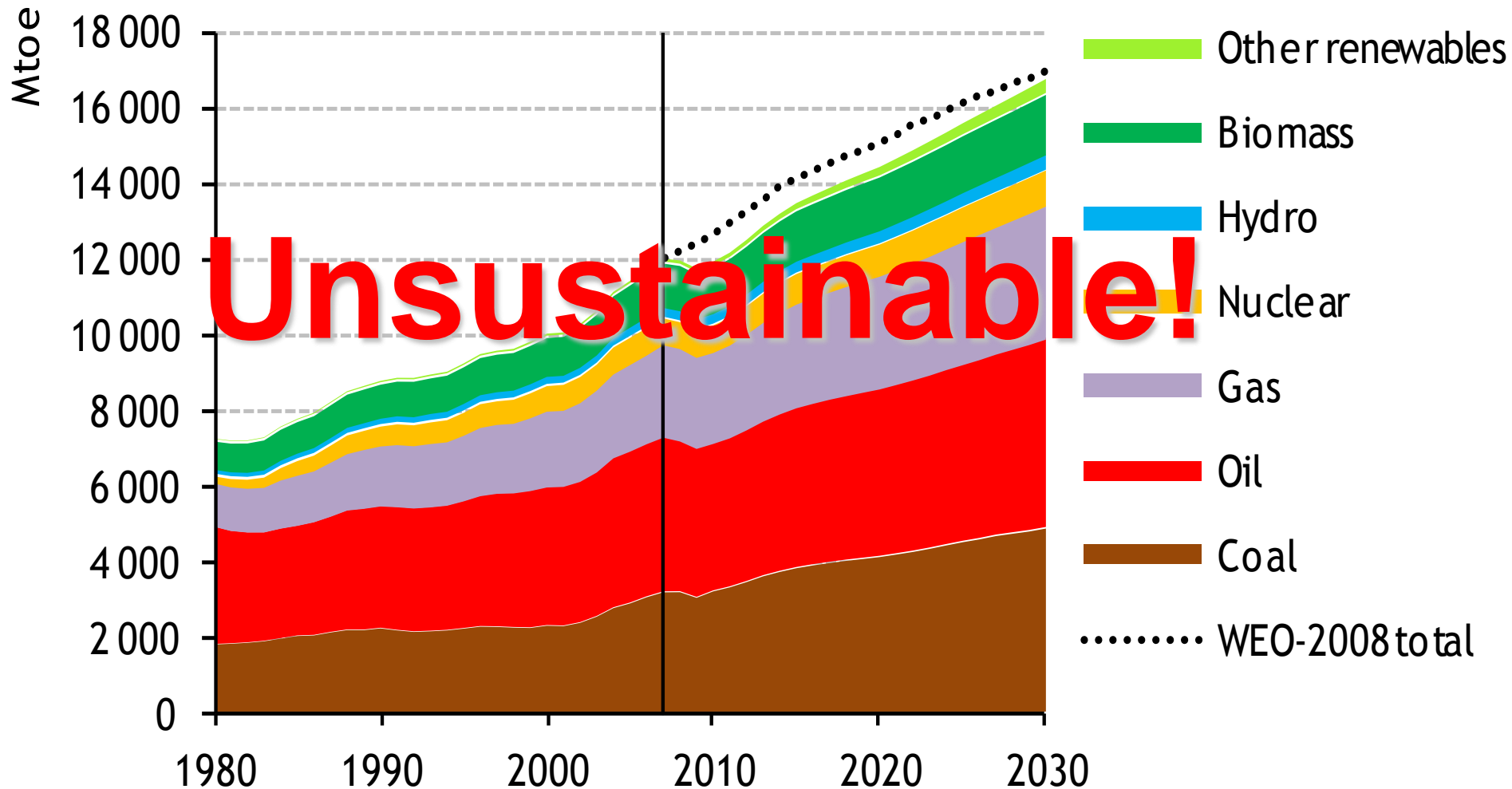




# Aims are to:

- Visit energy/climate scenarios;
- Describe some new and promising mitigation technologies;
- Consider costs and potentials;
- Question what do people really want;
- Discuss the possible roles for local governments and communities; and
- Stimulate some discussion.

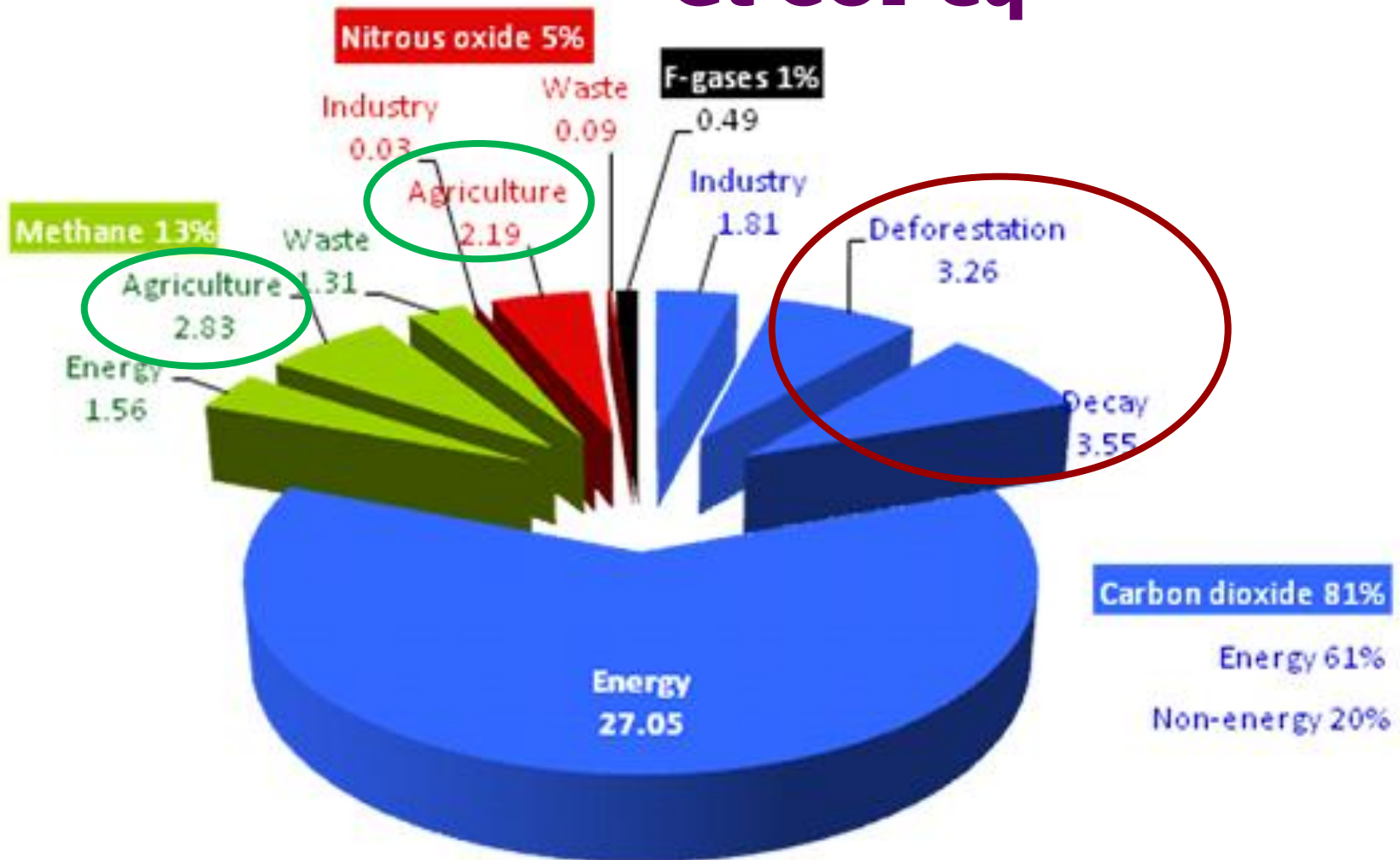
# World primary energy demand to 2030 - IEA World Energy Outlook, Reference Scenario



**Current policies will lead to growth of 45% in energy demand by 2030 and a fossil fuel future.**



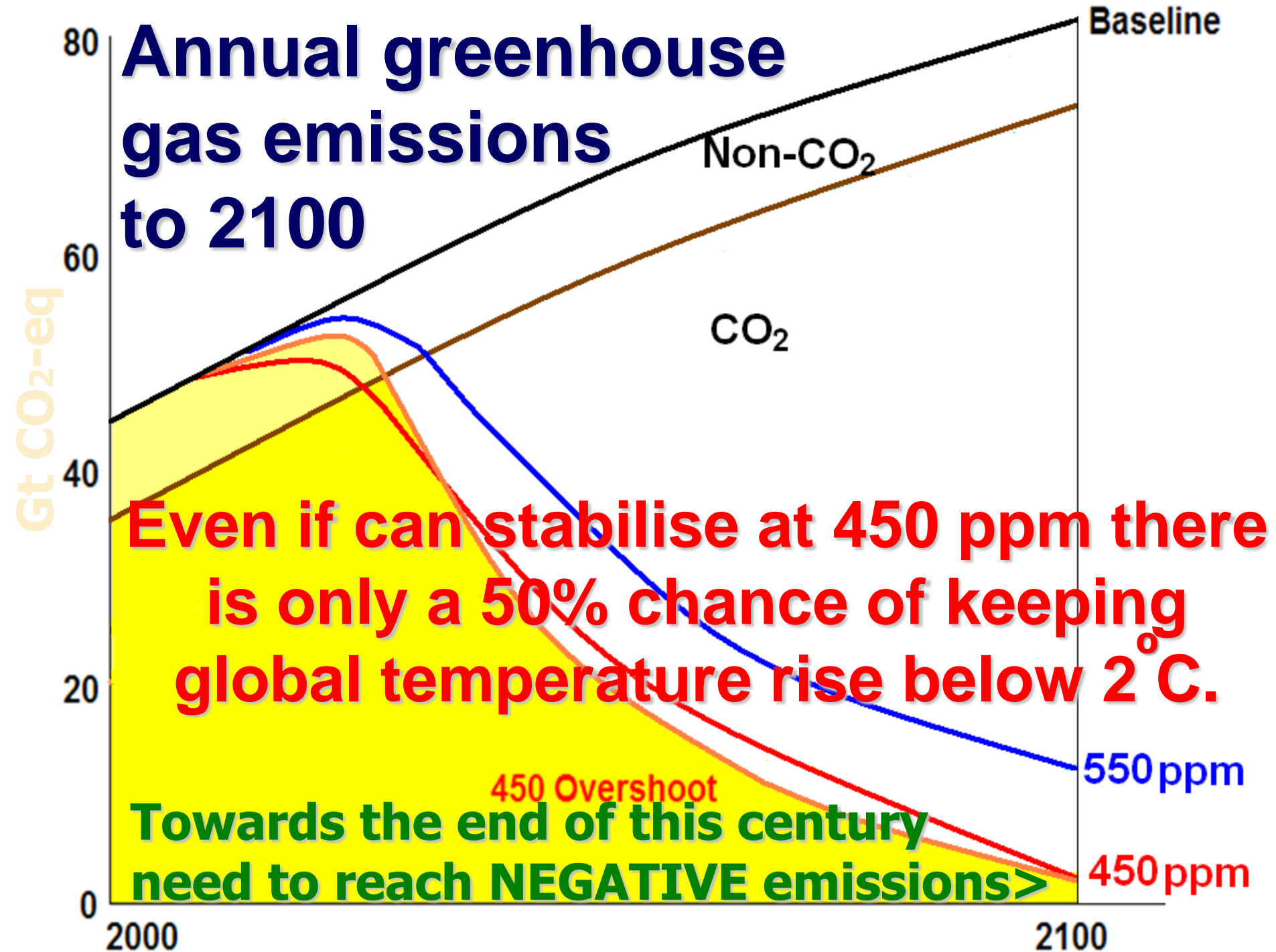
# Annual global greenhouse gas emissions Gt CO<sub>2</sub>-eq



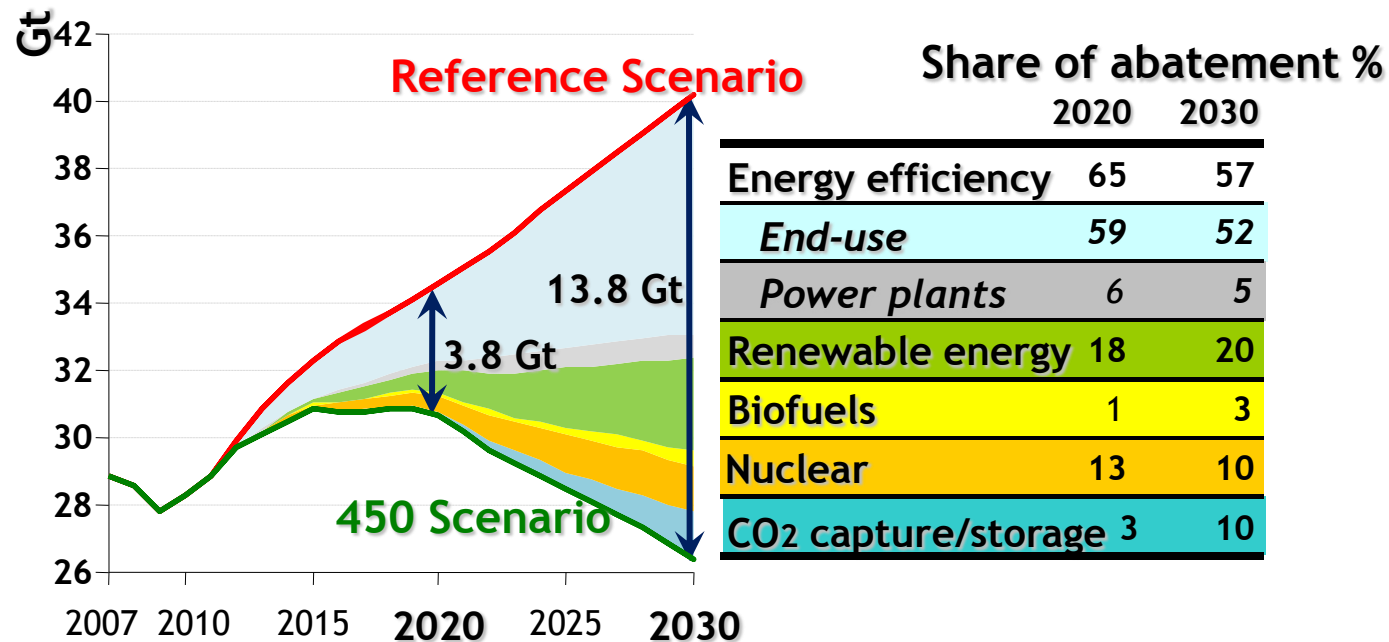
**Energy ~65%. Agriculture around ~12%.  
Land use change ~15%.**



# Annual greenhouse gas emissions to 2100



# World abatement of energy-related CO<sub>2</sub> emissions in IEA WEO 2009

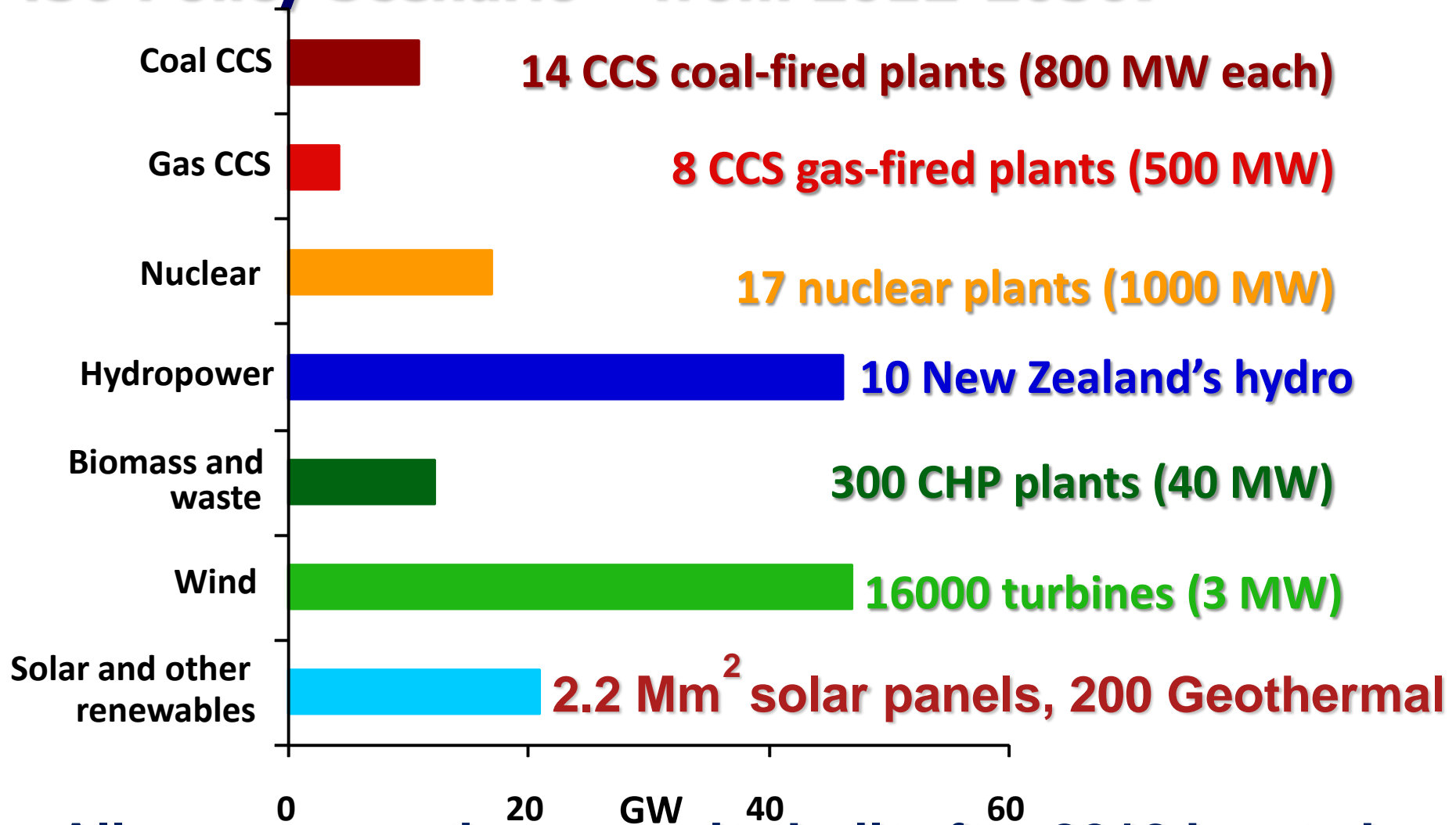


**Efficiency measures account for two-thirds of the 3.8 Gt CO<sub>2</sub>-eq abatement in 2020.**

**Renewables contribute close to one-fifth.**

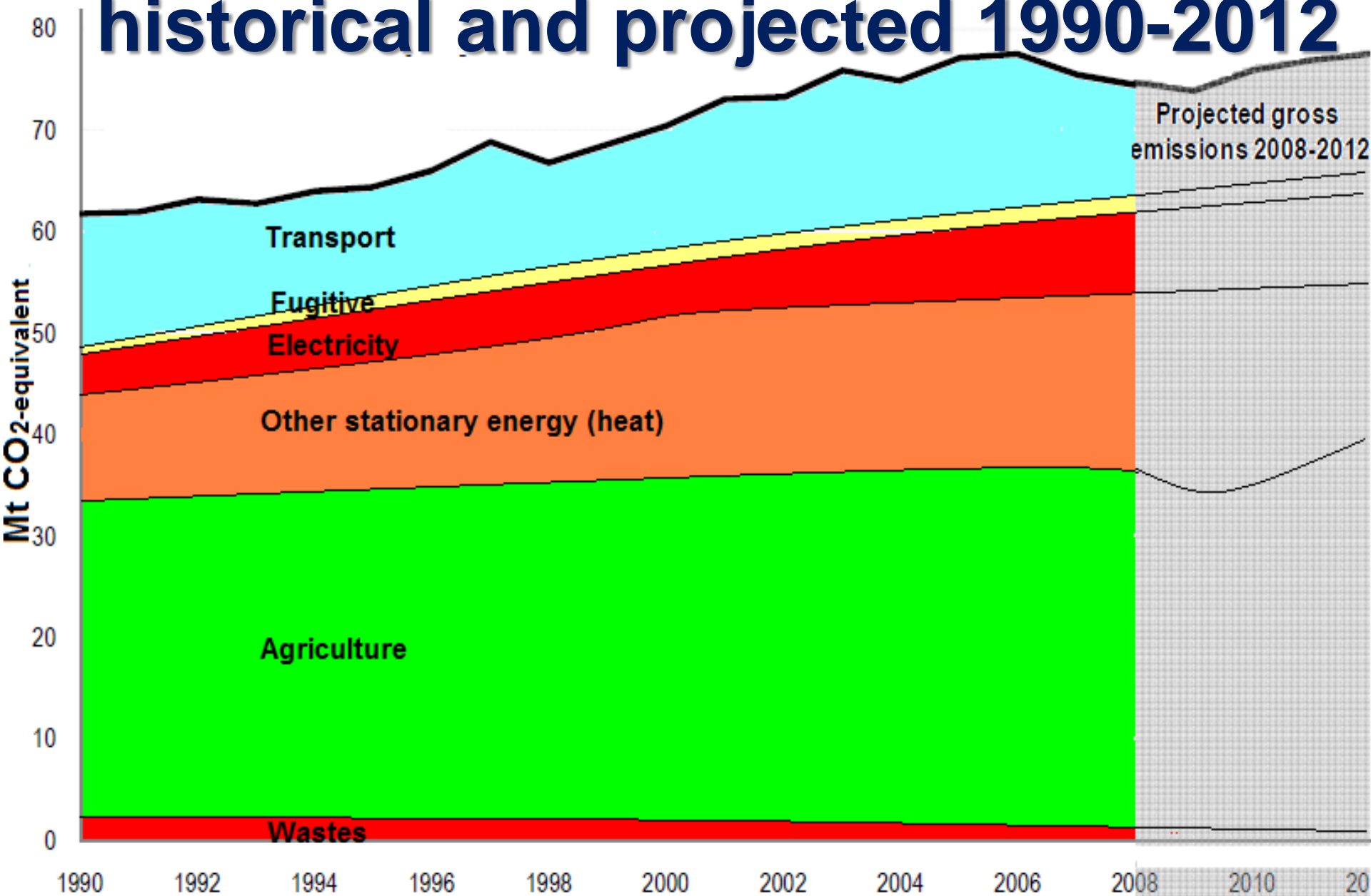


# Annual power capacity additions needed for the 450 Policy Scenario – from 2012-2030.



**All new generating capacity built after 2012 has to be “carbon-free” and 15% of existing capacity retired early.**

# NZ GHG emissions- historical and projected 1990-2012





# **Some popular perceptions of climate change:**

- Technology will solve it.**
- Weather has been changing forever.**
- CO<sub>2</sub> was higher a million years ago.**
- Won't affect me in my life time.**
- We'll be able to adapt easily.**
- Warmer summers will be good.**
- It's the fault of the Americans.**
- Developing countries should use less.**
- Crops will grow better with more CO<sub>2</sub>**
- I wish it would all go away.**
- The climate science is proven wrong.....**

# **Role of the IPCC**

## **Intergovernmental Panel on Climate Change**

- **Reports on the published literature – climate science, adaptation, mitigation.**
- **Does not produce policy advice.**
- **Careful author selection process.**
- **Heavily peer reviewed.**
- **Uncertainties defined.**
- **143 models being reviewed.**
- **Climategate – East Anglia Uni.**
- **Produced by humans – who sometimes make errors.....**



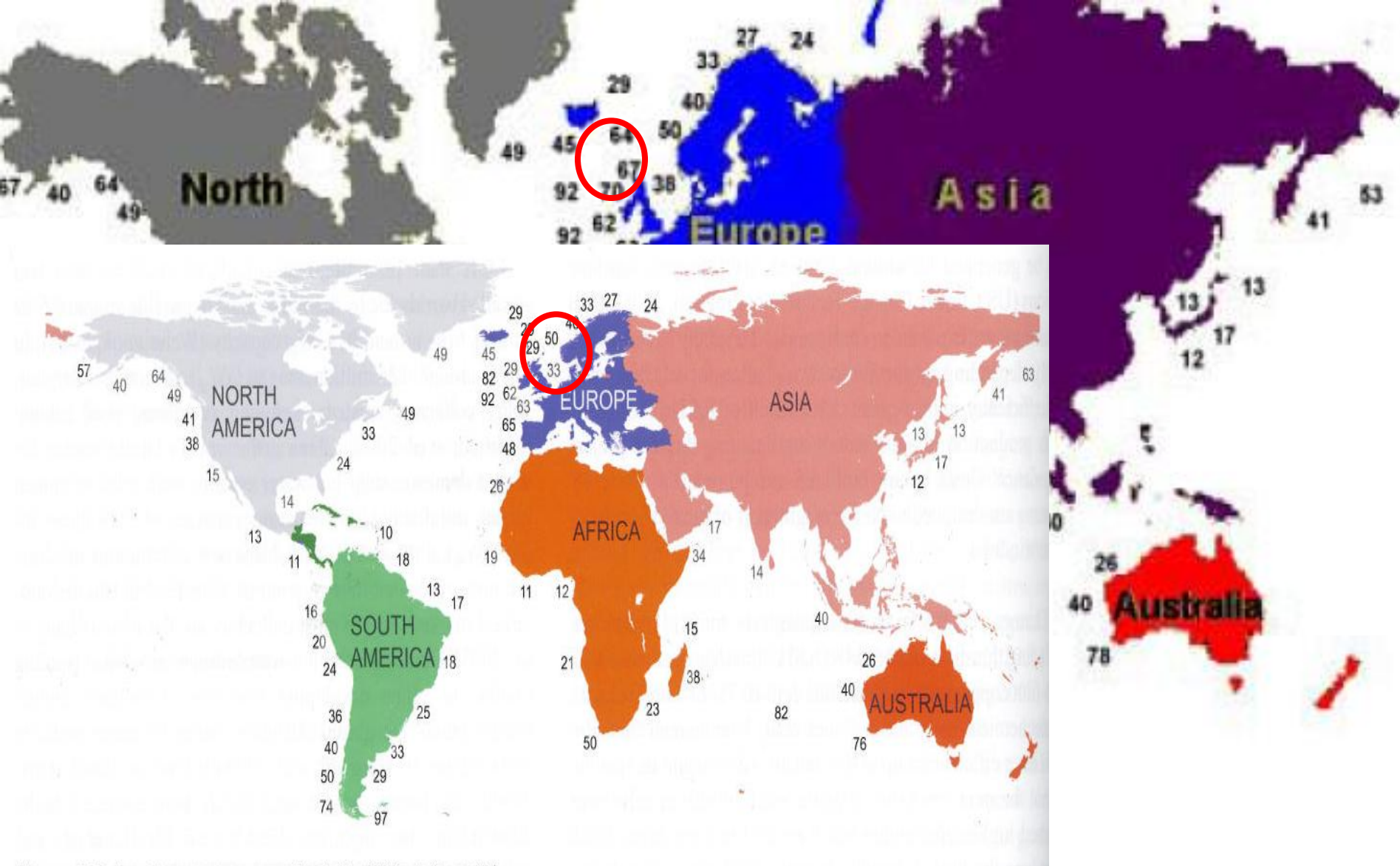
**6 February 2010.**

**“Sunday Telegraph discovers a series of new flaws in IPCC report”.**

**A diagram used to demonstrate the potential for generating electricity from wave power has been found to contain numerous errors.**

**The source of information for the diagram was cited as the website of UK-based wave-energy company Wavegen. Yet the diagram on Wavegen’s website contains *dramatically different* figures for energy potential off Britain and Alaska and in the Bering Sea. When contacted by The Sunday Telegraph, Wavegen insisted that the diagram on its website had not been changed.**

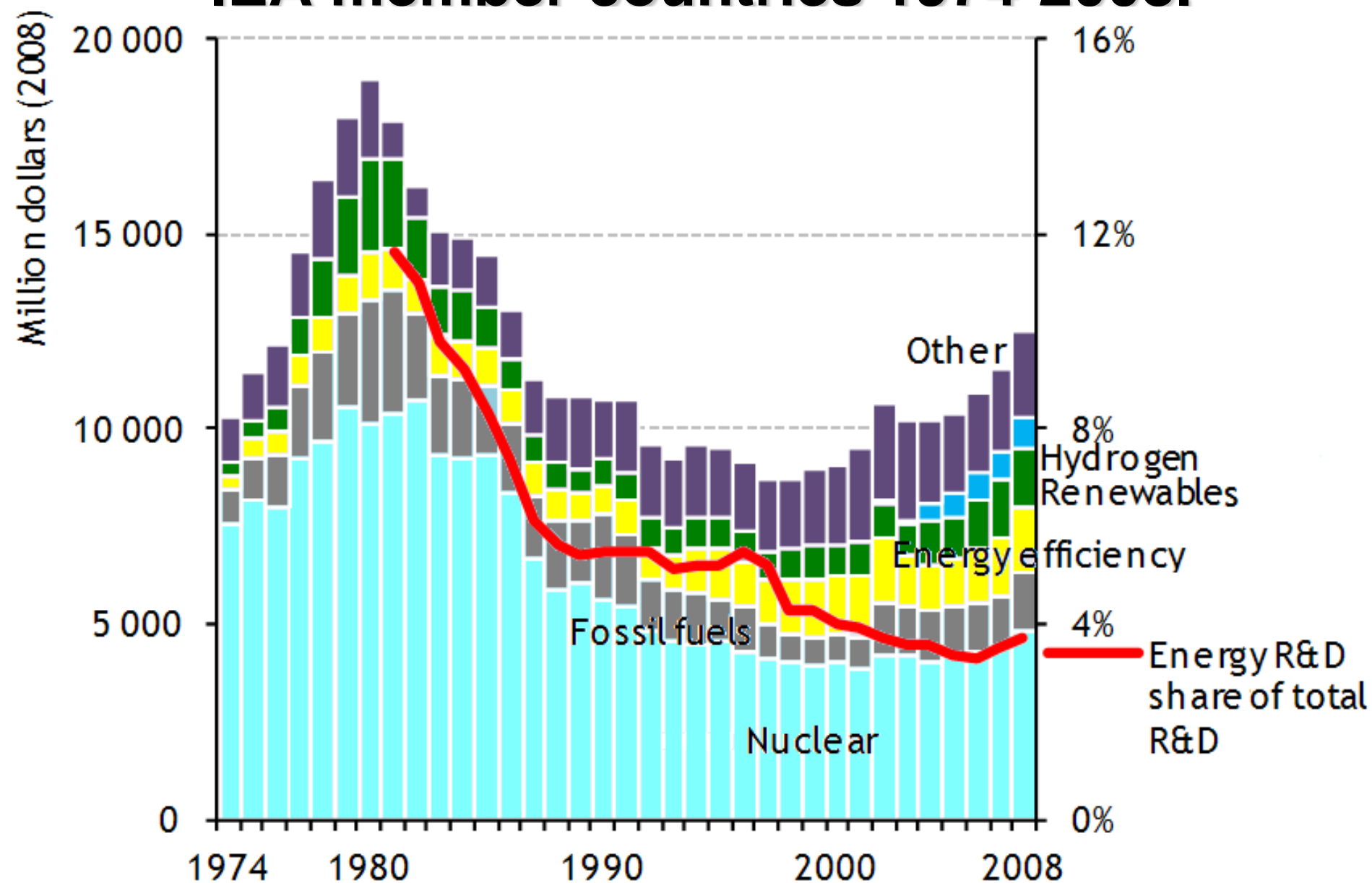
**Experts claim that, had the IPCC checked the citation properly, it would have spotted the discrepancies.**



**The best *wave energy* climates (Fig. 4.16) have deep water power densities of 60-70 kW/m. Around 2% of the world's 800,000km of coastline exceeds 30kW/m giving a technical potential of around 500 GW. The total economic potential is estimated to be well below this.**



# Public RD&D budgets for energy - IEA member countries 1974-2008.



# RD&D Investment in Clean Energy

	<u>2008</u>	<u>2009</u>
<b>Public sector</b>	<b>\$ 6.5 bn</b>	<b>\$ 9.7 bn</b>
<b>Private sector</b>	<b>\$17.7 bn</b>	<b>\$14.9 bn</b>

**Much of the investment in “smart energy” technologies.**

***Global Trends in Sustainable Energy Investment 2010  
UNEP (SEFI) and Bloomberg New Energy Finance.***



# Renewable Energy Policies

- **85 countries (45 developing) have policy targets and 83 (42) promotion policies.**

**(REN21 Global Status Report, 2010; IPCC SRREN, 2011)**

- **China's Renewable Energy Law -  
now the highest investor in clean energy.**

- **1989 - 1% of a small world PV market.**
- **2009 - 32% of much larger PV market.**
- **2009 - 15% of global new wind generation.**

***"The country that leads the development of  
clean energy technologies will be the country  
that leads the world."***

# **New investment in Clean Energy 2009**

➤ <b>Large hydro</b>	<b>\$ 20 bn</b>
➤ <b>Solar water heaters</b>	<b>\$ 13 bn</b>
➤ <b>Other RE projects + DG</b>	<b>\$113 bn</b>
➤ <b>Energy efficiency, R&amp;D,etc</b>	<b>\$ 46 bn</b>
➤ <b>Mergers and acquisitions</b>	<b>\$ 61 bn</b>
➤ <b>TOTAL</b>	<b>~\$250 bn</b>

**Down only 7% from 2008**

**Fossil fuel thermal power systems ~\$ 100 bn**

**Oil and gas industries ~\$ 400 bn**

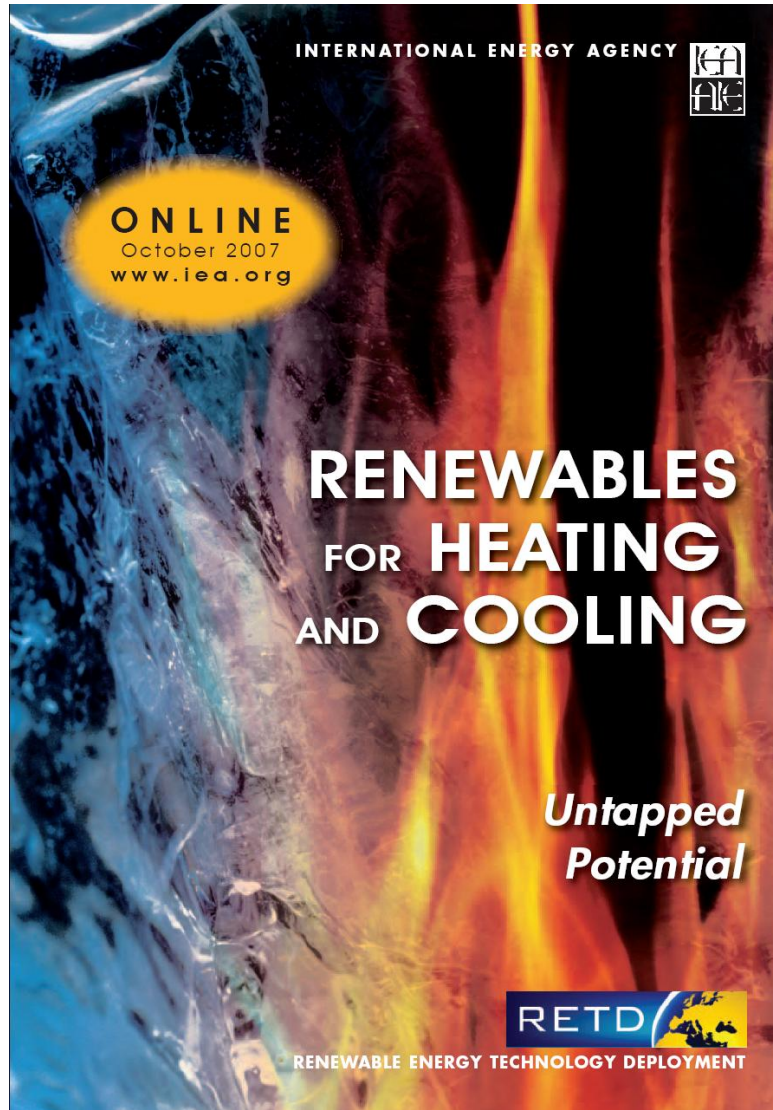
**Annual fossil fuel subsidies ~\$ 300 bn**

# **Clean Energy Investment**

- **Relatively resilient to financial downturn.**
- **A determination by some governments to turn financial crisis into green growth.**
- **Stimulated by green stimulus packages.**
- **Leading banks helping to bridge the finance gap.**
- **Insurance sector reducing risks of renewable energy projects.**



# Renewables for Heating and Cooling – the sleeping giant!



**40% of our energy use is to provide heat!**

**Biomass, geothermal and solar provides**

**15-16% of it.**

**Free download of the 200 page report from**

**[www.iea.org](http://www.iea.org)**

# The report examined the various REHC technologies and markets.

	Installed capacity <b>GW<sub>th</sub></b>	Energy output <b>PJ/yr</b>
<b>Solar thermal</b>	<b>100-110</b>	<b>200-220</b>
- water and space heating		
- solar assisted cooling	<b>&lt;0.05</b>	
<b>Bioenergy</b>	<b>1000-1200</b>	<b>3000-4000</b>
- pellet heating		
- CHP		
- anaerobic digestion		
- MSW waste-to-energy		
<b>Geothermal</b>	<b>25-30</b>	<b>270-280</b>
- deep conventional		
- deep advanced		
- shallow geothermal		
<b>Total</b>		<b>3500-4500 PJ/yr</b>

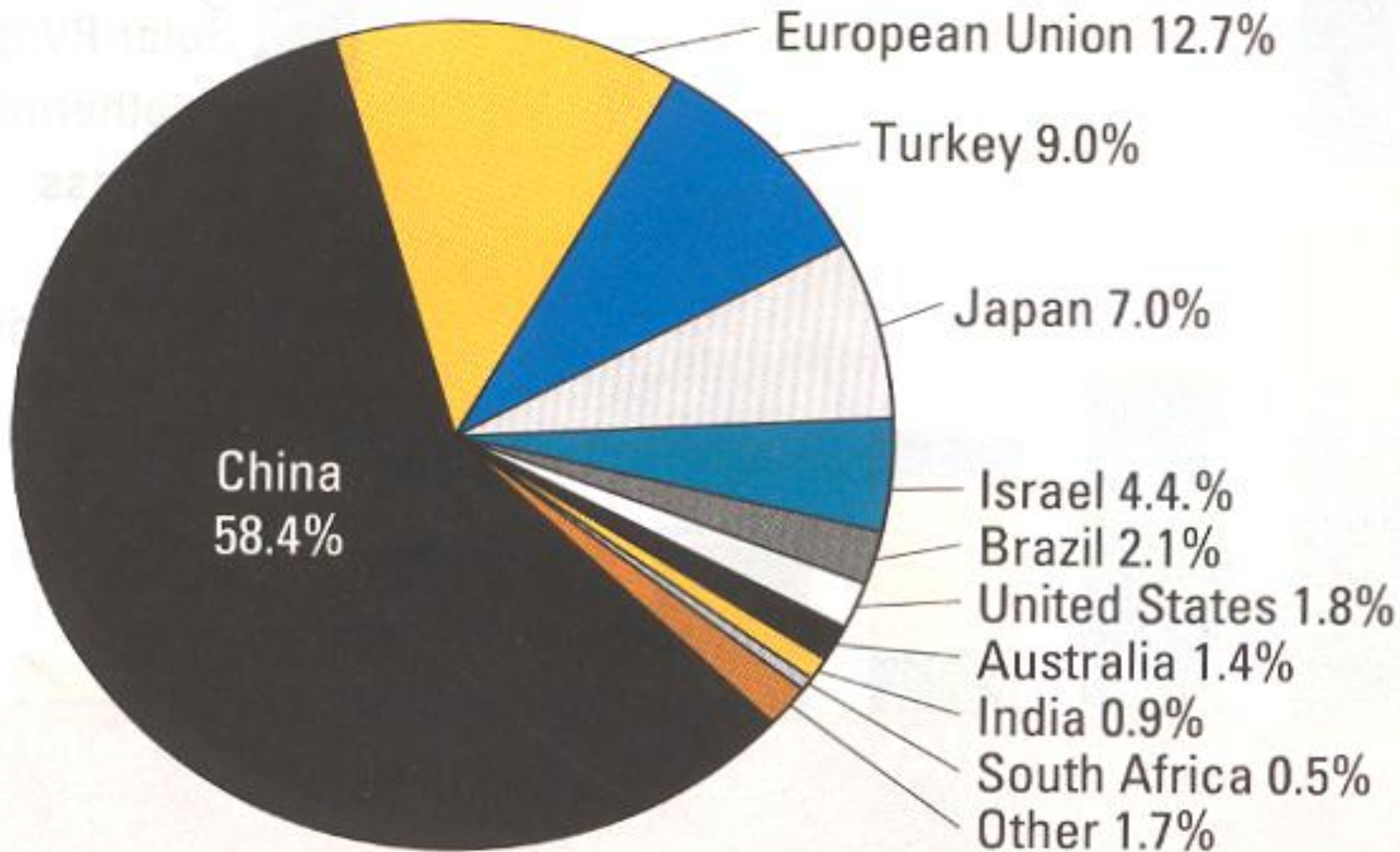
By way of comparison:

Biofuels use in 2006 was around 1200 PJ/yr

Renewable electricity (excluding hydro) around 1800PJ/yr.



# Solar water heating - 150 GW<sub>th</sub> installed on 40 million dwellings







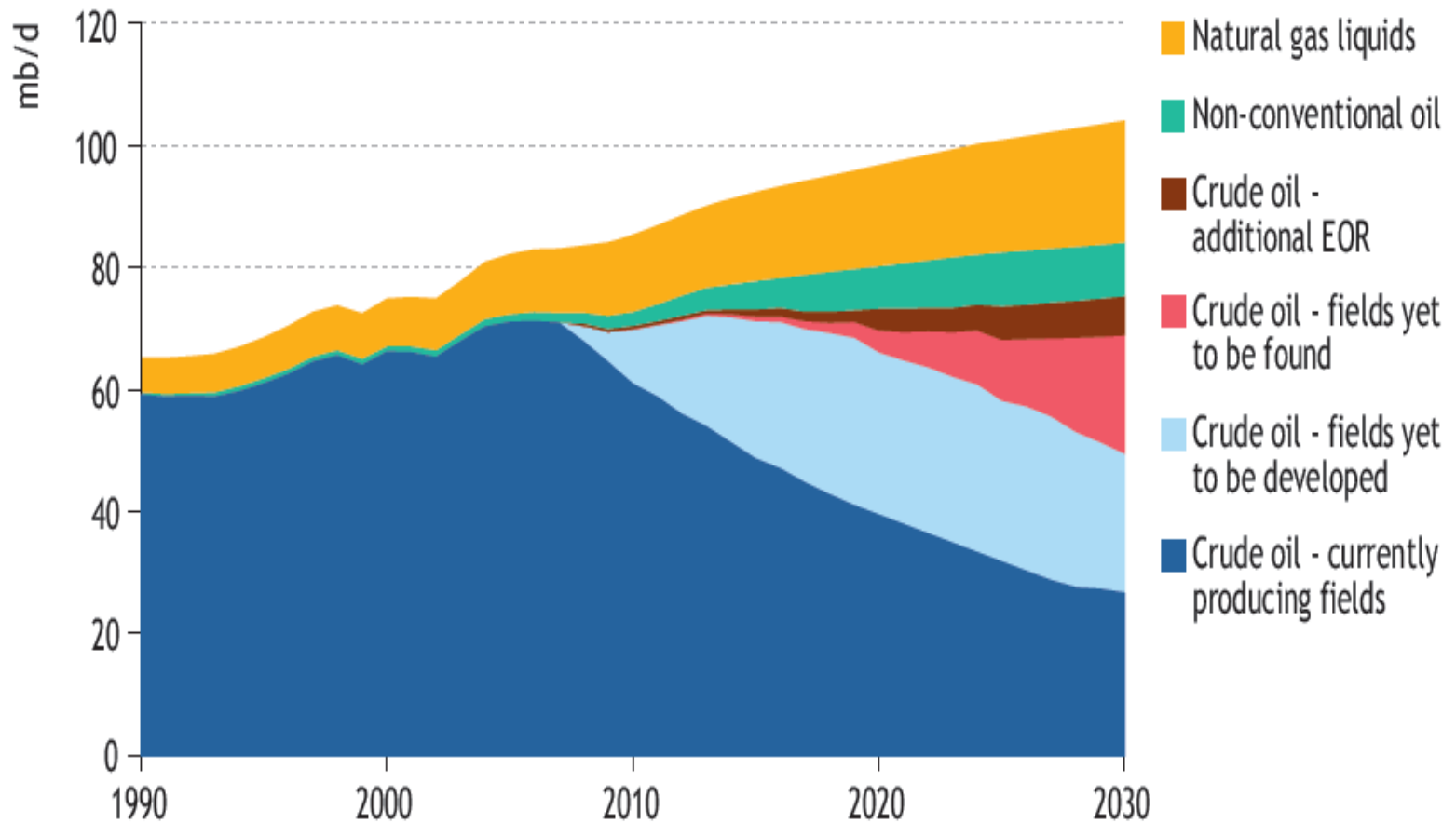
**Pine bark beetle  
killing forests.  
Pellets –W Canada  
to Europe**





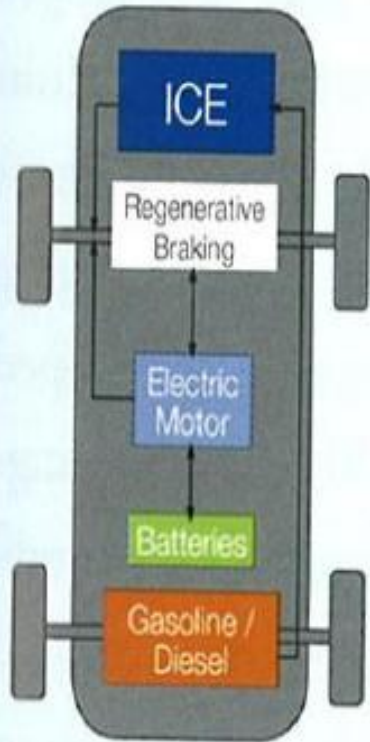
# The end of cheap oil

## World liquid fuel production by source in IEA WEO 2008 Reference Scenario

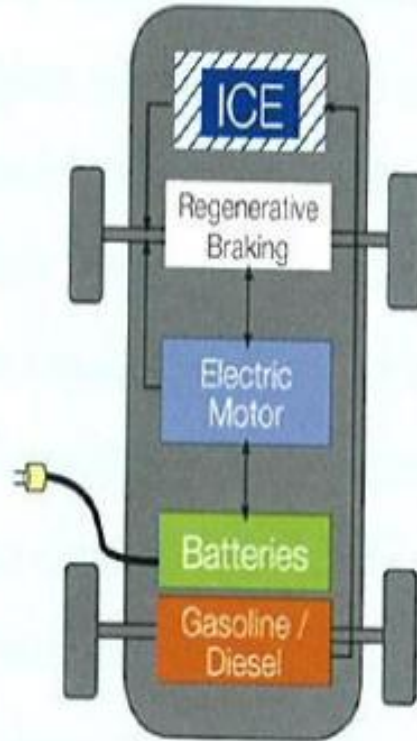


***Six times the current oil capacity of Saudi Arabia needs to be developed between 2010 & 2030.***

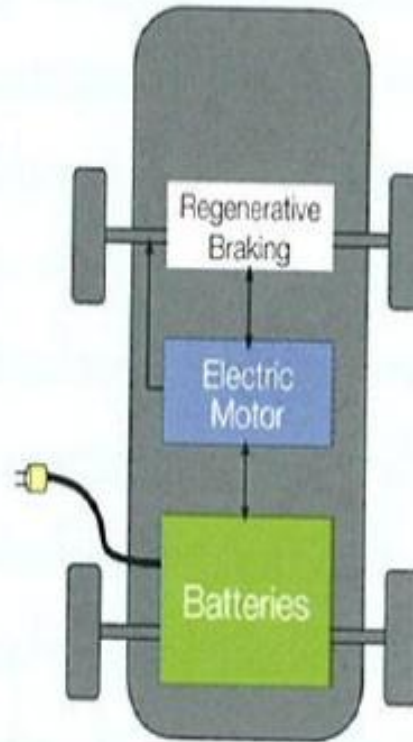
# Light duty vehicle power drive options



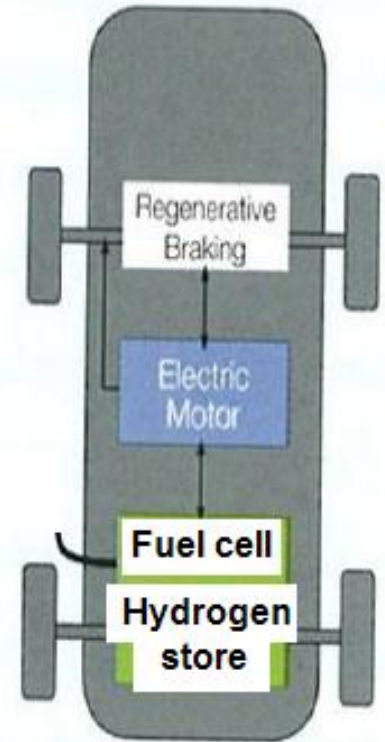
Hybrid electric vehicle



Plug-in hybrid vehicle



Battery electric vehicle



Hydrogen fuel cell vehicle



















# The Yike Bike!





# Masdar City UAE















fuelled with **LOW CO<sub>2</sub>**

**CELLULOSE**

**ETHANOL**



# FROM 1<sup>st</sup>- TO 2<sup>nd</sup>-GENERATION BIOFUEL TECHNOLOGIES

*An overview of current  
industry and RD&D activities*

RALPH SIMS, MICHAEL TAYLOR  
INTERNATIONAL ENERGY AGENCY

AND JACK SADDLER, WARREN MABEE

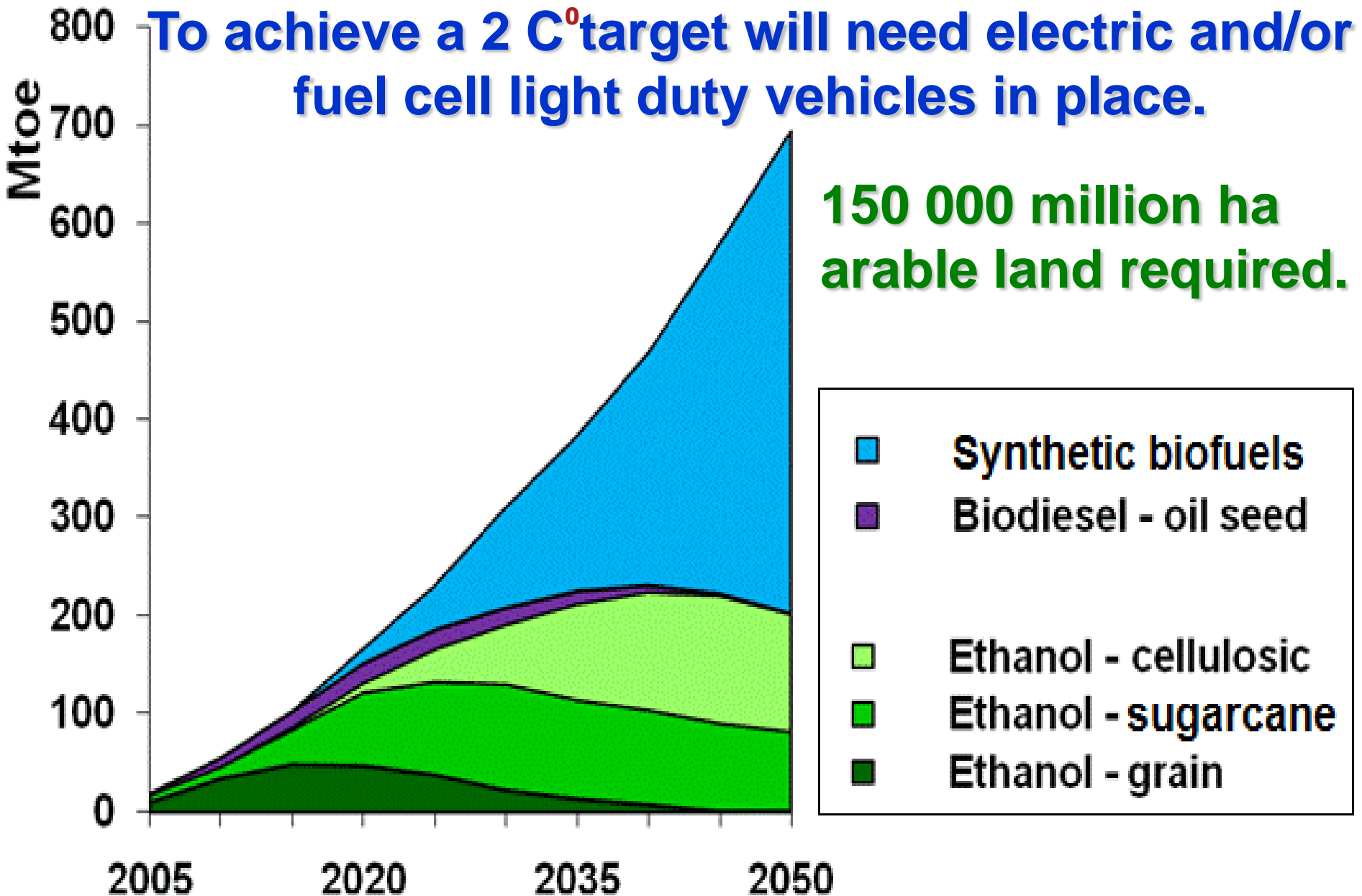
IEA Bioenergy

© OECD/IEA, November 2008

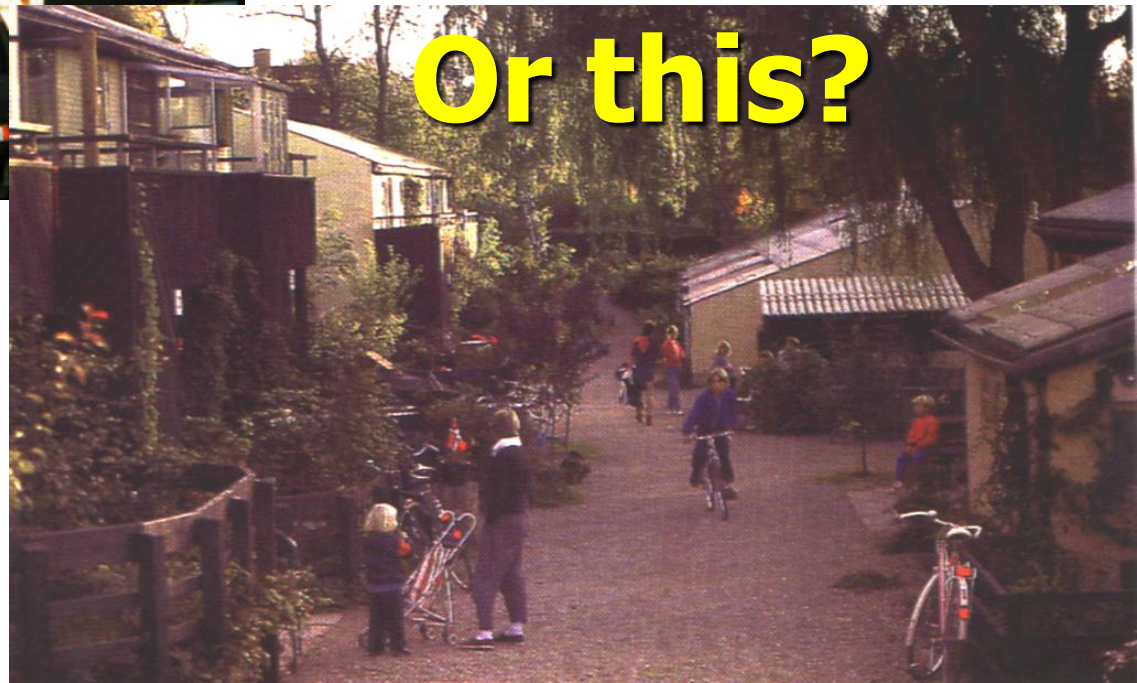
**Free downloads  
of the full 124  
page report are  
available from  
[www.iea.org](http://www.iea.org)**



# Biofuels in 2050 – IEA E.T.P. Scenario



# What do people want?





Attractions



**Are these people happy given all the energy services they could ever need?**



**Or are these people happier?**



**For 1600 million people, provision of modern energy services is the only hope of meeting the Millennium Development Goals.**











Award-winning service  
Just for you



# What do people want?

**Technical solutions??**

**Communication  
deployment  
energy**

**is the key to successful  
of sustainable  
technologies.**



**Social benefits??**

**Employment**

**New skills**

**Social cohesion**

**Wealth retention**

**Business  
opportunities**

**Pride and independence**

**Protection of recreational areas**

**Good health**

**Improved quality of life**

**Sense of community**

**Avoidance of climate change impacts**



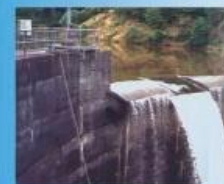


International  
Energy Agency



# CITIES, TOWNS & RENEWABLE ENERGY

**Yes In My Front Yard**



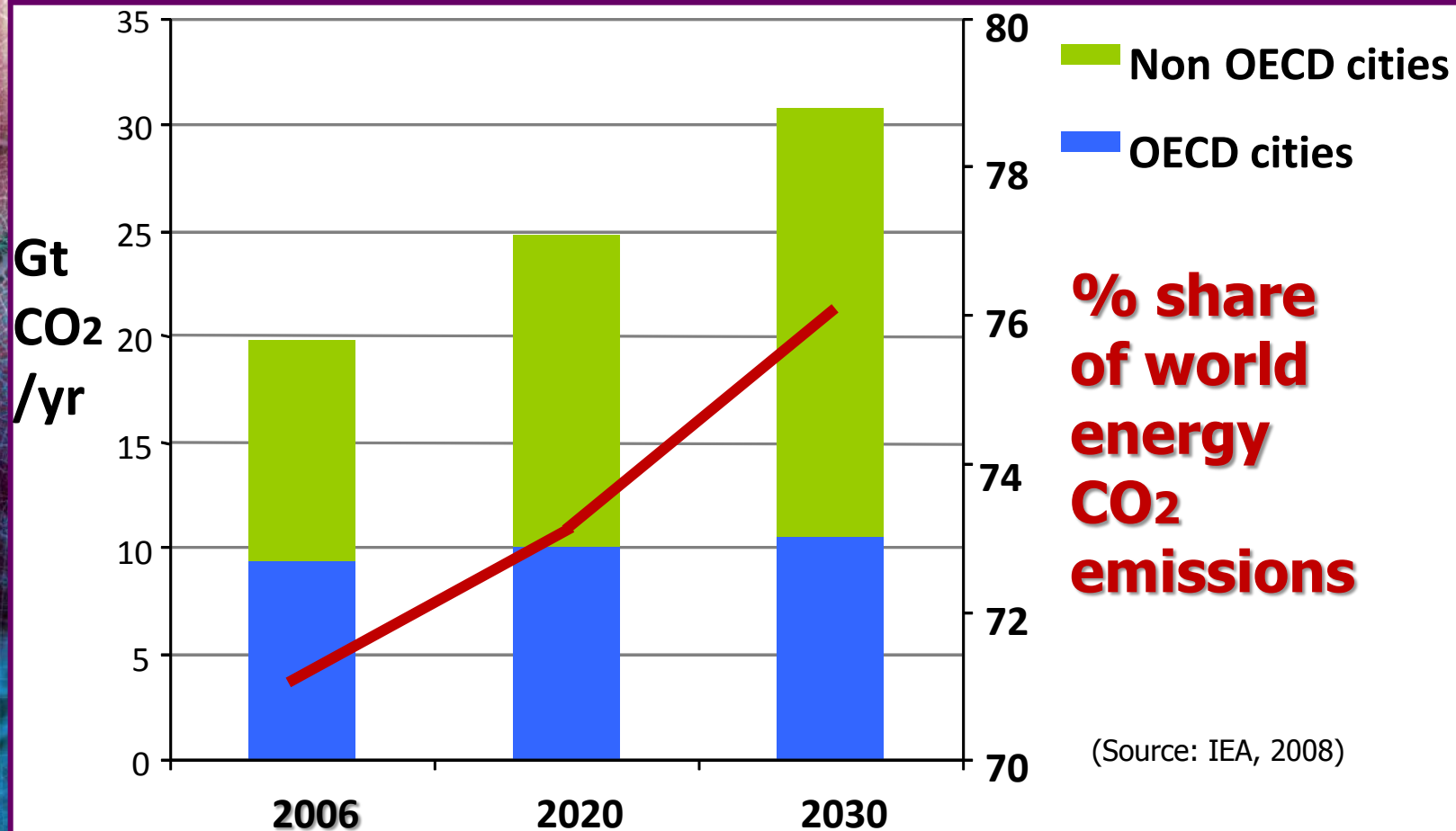
*Please note that this PDF is subject to specific restrictions that limit its use and distribution. The terms and conditions are available online at [www.iea.org/about/copyright.asp](http://www.iea.org/about/copyright.asp)*



# Objectives of the report:

- **For local policy makers - to gain greater understanding of the current and future potential for renewable heating, cooling, electricity and transport fuels.**
- **For local governments - to expand their roles by identifying possible benefits from enhanced renewable energy deployment for local citizens and businesses.**
- **For national, state and regional policy makers - to better appreciate the roles that local governments might play in increasing the uptake of renewables.**

# Why the interest in cities and towns?



(Source: IEA, 2008)

**Share of global energy-related CO<sub>2</sub> emissions increase from 71% in 2006 to 76% in 2030**



# a) Cities have local responsibilities:

**They regulate:**

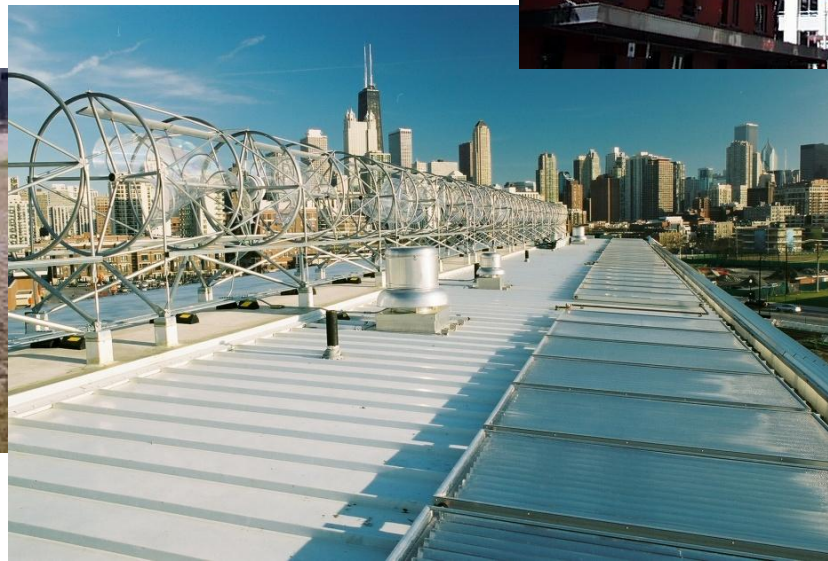
- **land use**
- **infrastructure**
- **public transport**
- **water supply**



## a) Cities have local responsibilities:

**They own:**

- **public buildings**
- **land**
- **vehicle fleets**
- **waste treatment facilities**





## b) Cities are close to the community:

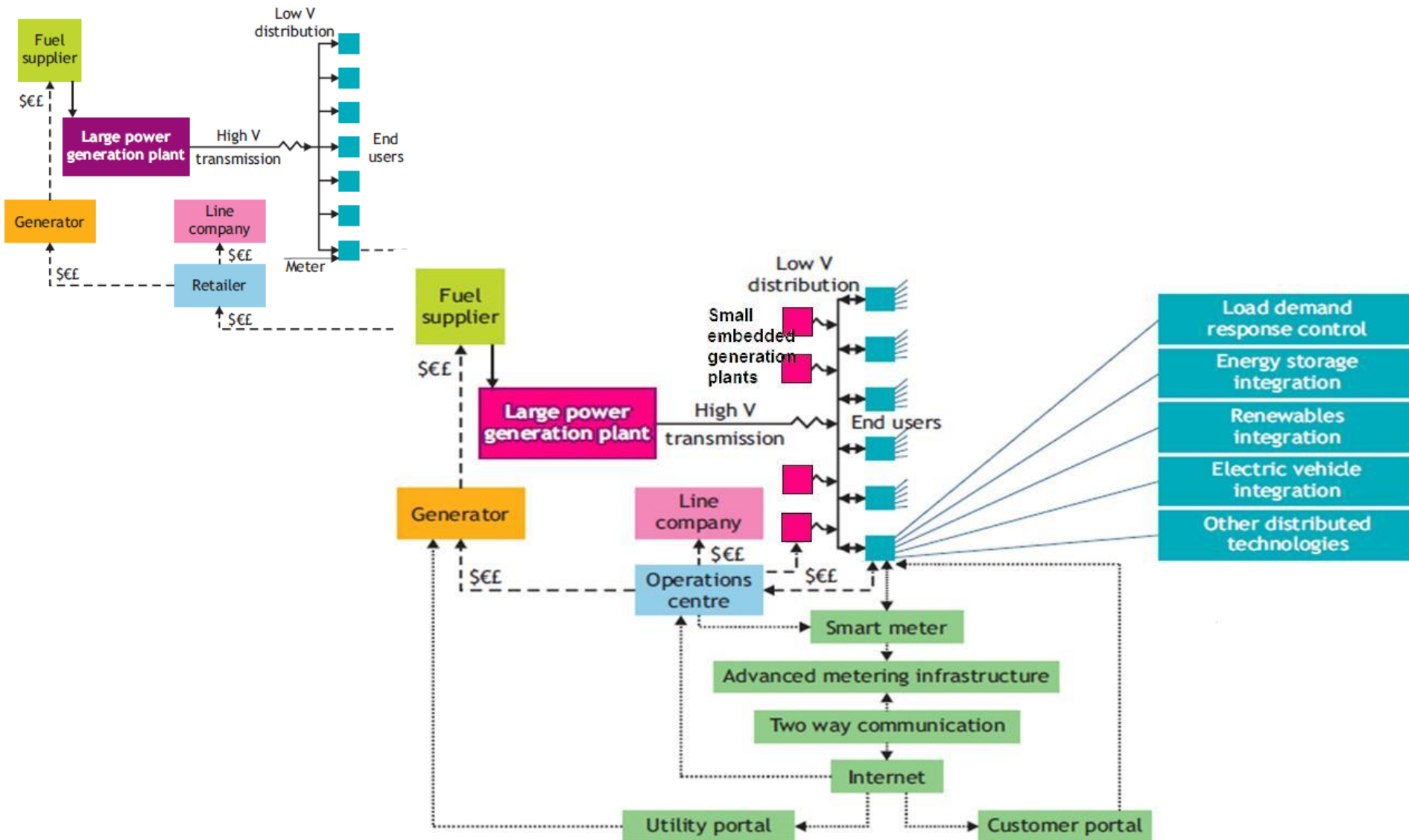
**They have proximity to**

- **citizens**
- **local businesses**



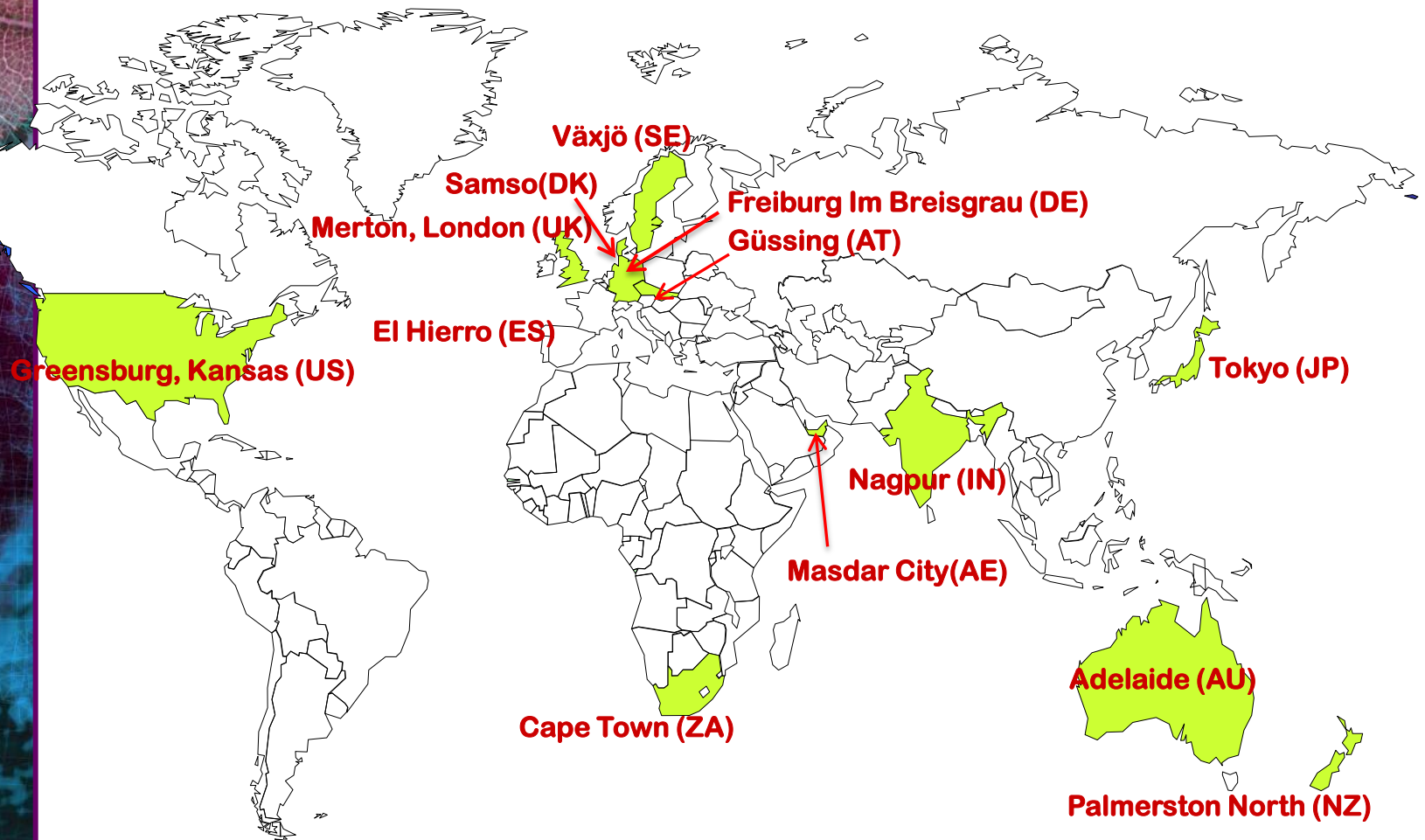
# What can cities help achieve?

## Maybe the digital energy revolution





# Which are the case studies?



# Case-studies

City / town	Population	Category
Tokyo, Japan	12,400,000	Wealthy mega-city
Capetown, S-Africa	3,400,000	Poor mega-city
Nagpur, India	2,100,000	Poor large city
Adelaide, Australia	1,160,000	Wealthy large city
Merton, London, UK	200,000	Mega-city leading district
Freiburg, Germany	200,000	Medium town
Växjö, Sweden	78,000	Small town
Palmerston North, NZ	75,000	Small town
Masdar City, UAE	40,000	Urban planning from new
El Hierro, Spain	10,000	One of Canary Islands
Samsø, Denmark	4,400	Island for comparison
Güssing, Austria	3,800	Small community – rural
Greensburg, USA	1,600	Rebuilding after tornado



# Case-studies

City or town	Policy classification																	
	Target		Urban planning	Stick		Standards and mandates	Capital grants and rebate	Operating grants	Carrot			Guidance		Voluntary -municipal operation		Voluntary -role model		
	Overall target	Sector specific target		Taxes	Building codes regulations/				Investment	Soft loans and guarantees	Tax credits	Tax reduction/exemption	Information/promotion	Training	Procurement / purchase	Investment	Utility	Demonstration / land use
1) Tokyo	X	X		X		X							X		X	X		
2) Capetown, S. Africa	X	X	X				X						X	X				
3) Nagpur, India	X	X		X							X	X	X		X		X	X
4) Adelaide, Australia	X	X					X						X		X		X	
5) Merton, London, UK	X	X	X	X		X							X					
6) Freiburg, Germany	X	X	X	X		X	X			X			X	X	X	X	X	X
7) Växjö, Sweden	X	X		X			X						X		X		X	X
8) Palmerston North, NZ	X	X													X	X	X	X
9) Masdar City, UAE		X											X		X	X	X	
10) El Hierro, Spain		X					X			X			X	X		X	X	X
11) Samso, Denmark		X					X			X			X		X		X	
12) Güssing, Austria		X				X							X	X	X	X	X	
13) Greensburg, USA		X	X	X					X			X	X			X	X	

# How can cities make a difference?

## 1) Targets

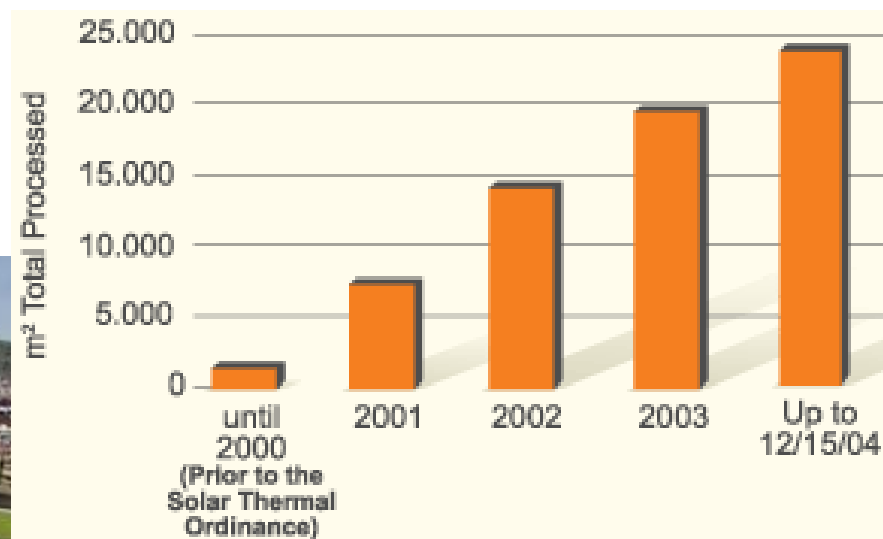
City	City target RES	National target
Tokyo (JP)	20% RES by 2020	3% RES by 2010
Adelaide (AU)	33% RES-E by 2020	8% RES by 2020
Växjö (SE)	54% RES today	49% RES by 2020
Masdar City (UAE)	CO2 neutral (2013)	7% RES by 2020
El Hierro (ES)	100% RES-E today	20% RES by 2020
Samsø (DK)	100% RES today (except T)	20% RES by 2011
Güssing (AT)	100% RES today	34% by 2020

City	City target CO2	National target
London (UK)	60% CO2 reduction 2025 compared 1990	26% CO2 reduction 2020 compared 1990



## 2) Regulations - Sticks!

### Barcelona Solar Ordinance



**“The Merton Rule”  
Merton Borough,  
London -**

# 3) Financial incentives - Carrots!

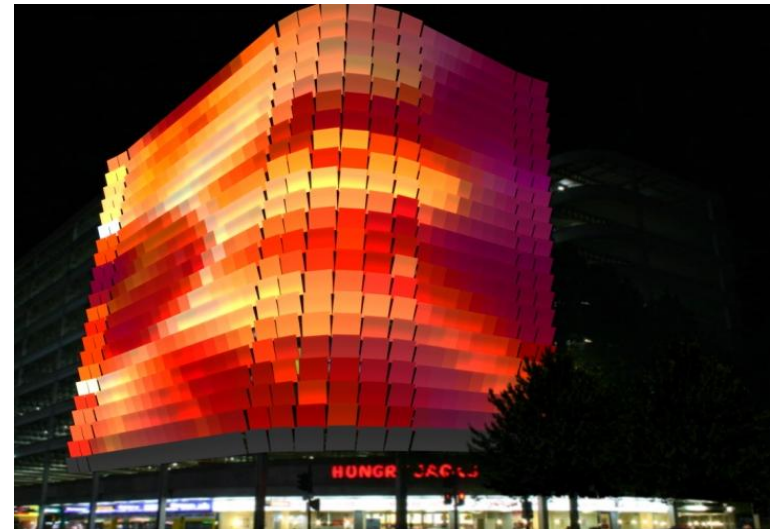
## Freiburg im Breisgau, Germany





# 4) Training / Information (Guidance, education, demonstration)

## Adelaide, Australia



# 5) Voluntary actions (Operation, self-governance, leadership)

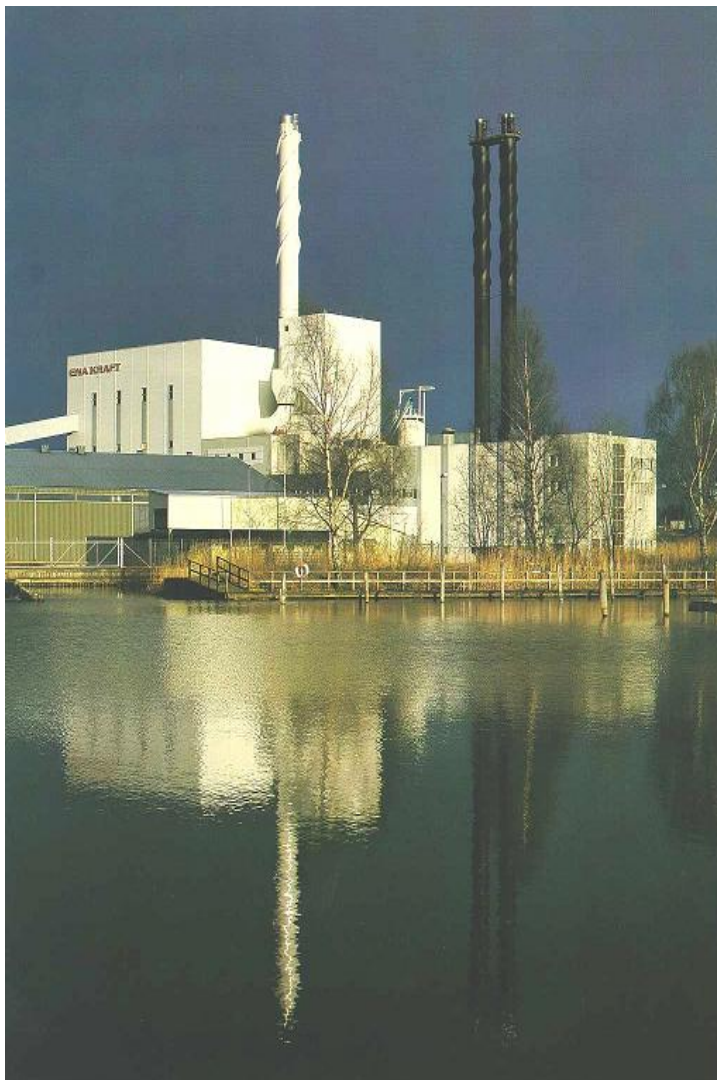
## Greensburg, Kansas (US)





# Why should they do it?

## a) Energy security, competitiveness



**100% renewable  
heat and power:**

**Växjö, Sweden**

**Güssing, Austria**

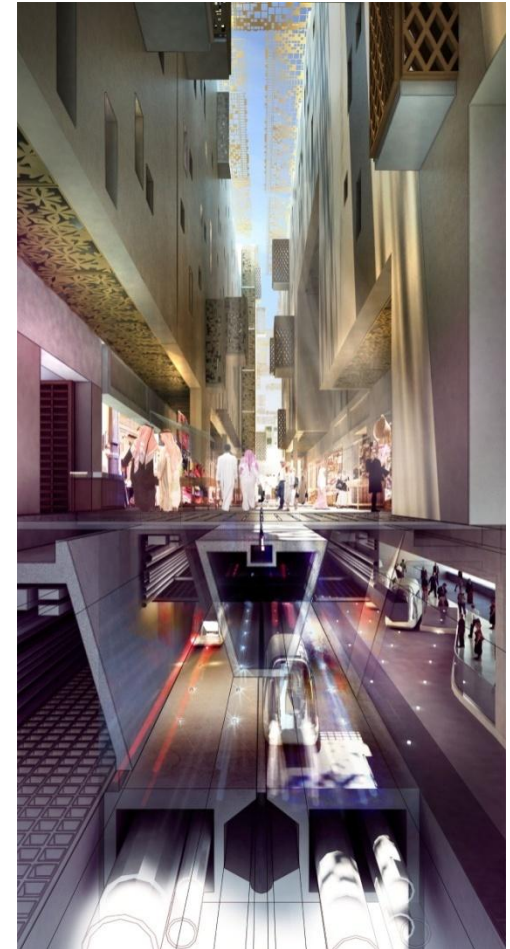
**Samsø, Denmark**

**El Hierro, Canary  
Islands**



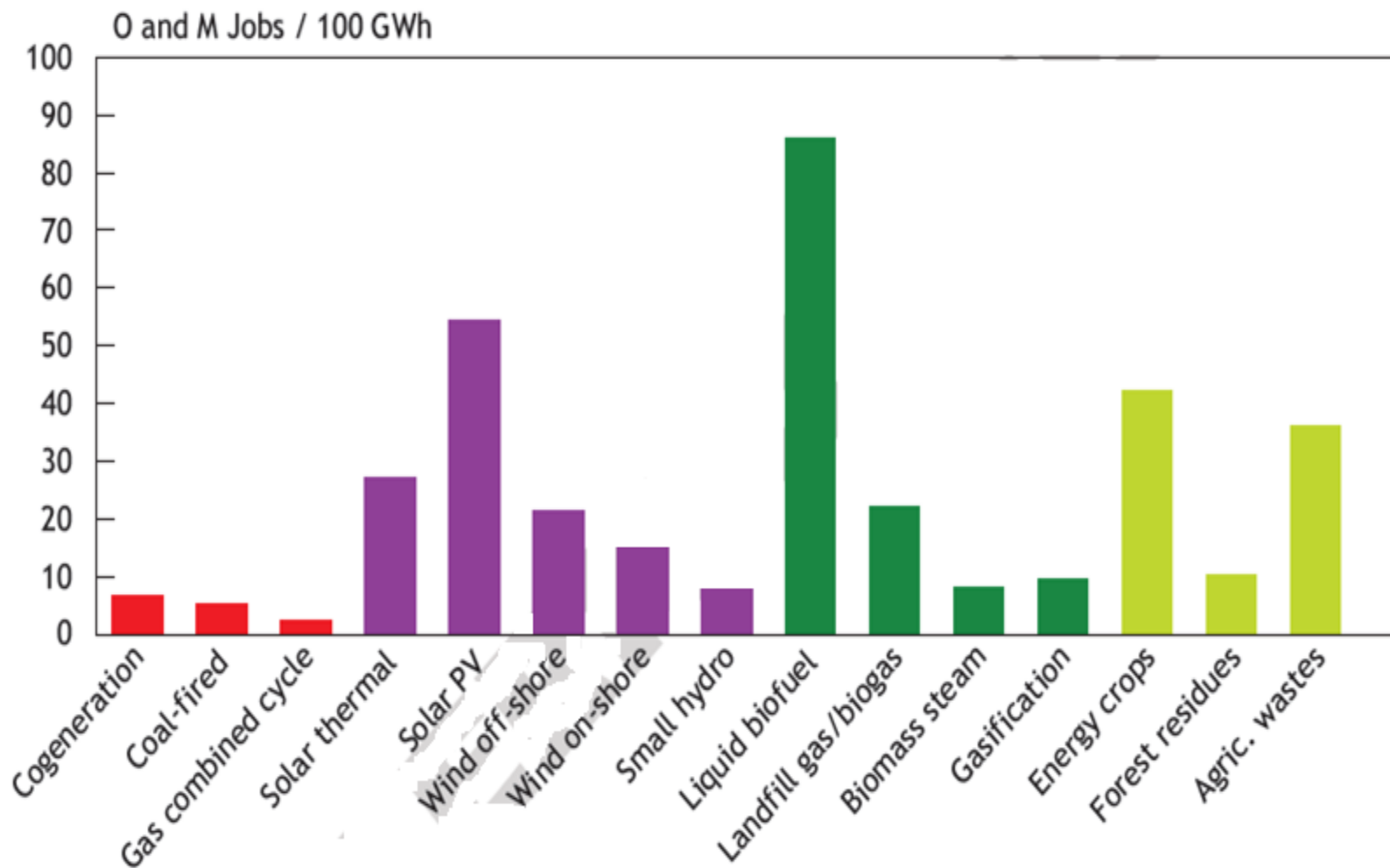
## **b) Reduce congestion and air pollution; reduce cooling demand.**

### **Masdar City (UAE). Under construction**





## c) Encourage local economic development and growth



Source: IEA, 2007b

## d) Support new local industry



**Whispergen**

**Micro-  
CHP  
system**





# Policy recommendations for local governments

- Learn from other town and city examples, but fit them to local circumstances.
- Expand analysis of the potential role of a city in enhancing renewable energy.
- Deploy renewable energy in parallel with energy efficiency measures.
- Develop policies that support the transition to decentralised heating, cooling and power generation systems.



# In summary

- Climate change is happening.
- Adaptation is inevitable.
- Technologies have a key role to play to keep global mean temperature rise below 2°C.
- RD&D investment in clean technologies is inadequate to drive the necessary transition.
- Society is aware of the issues but declining to accept the implications or to respond.
- Municipal governments can participate by incentivising their local communities.
- We are running out of time - so should take some personal responsibility and not wait for businesses and governments to lead.