

Decentralized Energy Technologies – A Solution for New Zealand

Wellington, New Zealand
October 23, 2007

David Sweet – Executive Director
World Alliance for Decentralized Energy (WADE)

Edinburgh, Washington, Edmonton, Beijing

The Extreme Future by James Canton

Top Trends of the “Extreme Future”

- 1) Fueling the Future: The energy crisis, the post-oil future, and the future of energy alternatives like hydrogen. **The critical role that energy will play in every aspect of our lives in the 21st century.**
 - The Innovation Economy
 - The Next Workforce
 - Longevity Medicine
 - Securing the Future
 - Globalization
 - Climate Change

Our Global Energy Choices

- Energy Security or Insecurity? (race for supply and CIP)
- Energy Prosperity or Poverty? (access, reliability, affordability)
- Clean Tech or Pollution? (climate change and health drivers)
- Energy Price Volatility or Stability? (O&G supply down and demand up)
- Energy Innovation or Stagnation?
 - Who will be the superpowers in the new global economy?
 - [When] Will rising energy prices and declining costs for new technology and efficiency bring innovation “into the money”?

Doomsday Scenario

“The world will soon start to run out of conventionally produced oil. If we manage somehow to overcome that shock by shifting the burden to coal and natural gas, the two other primary fossil fuels, life may go on more or less as it has been – until we start to run out of all fossil fuels by the end of this century... Even if human life does go on, civilization as we know it will not survive, unless we can find a way to live without fossil fuels.”

Out of Gas, by David Goodstein

A Contrarian Voice

- “The raw fuels are not running out. The faster we extract and burn them, the faster we find still more.”
- “The cost of energy as we use it has less and less to do with the cost of fuel.”
- “The more efficient our technology, the more energy we consume.”
- “The competitive advantage in manufacturing is now swinging decisively back toward the United States.”

The Bottomless Well, by Peter Huber
and Mark Mills

What are We Waiting For?



The Energy [R]evolution

“Decentralized energy systems where power and heat are produced close to the point of final use, avoid the current waste of energy during conversion and distribution. They will be central to the Energy [R]evolution, as will the need to provide electricity to the two billion people around the world to whom access is presently denied.”

About WADE

- Non-profit research, promotion and advocacy organisation started in 1997
- Mission is to accelerate the worldwide deployment of high-efficiency cogeneration, on-site power and decentralized energy systems
- WADE is supported by:
 - National DE organisations
 - *UK CHPA, USCHPA, Cogen Europe etc.*
 - CHP/DE companies with international interests
 - *Thermax, Capstone, Siemens, Caterpillar, Solar Turbines, FuelCell Energy, MTU, Marubeni, Primary Energy, Wärtsilä, etc*

WADE Mission

- WADE Research activities
 - Reports, market surveys and studies
 - WADE Economic Model
- WADE Advocacy activities
 - Policy advise for governments
 - Participation in legislative and regulatory proceedings
 - Cooperation with International Organisations, Institutions and NGOs
- WADE Promotion activities
 - WADE Conferences and events
 - WADE Newsletters

WADE Advocacy – International Cooperation

Green Groups

- Greenpeace International
- WWF International
- Friends of the Earth

International Financial Institutions

- World Bank
- IFC
- Asian Development Bank
- Inter American Development Bank
- Commercial Banks

Other major International Groups

- UN
- IEA
- WEC
- REEEP

Associations

- Cogen Associations
- District Energy Groups
- Solar Groups
- Wind Groups
- Natural Gas Groups - IGU
- Regulatory Associations

Governments

- European Commission
- Chinese NDRC
- Mayor of London's Office
- Pakistan Legislative Delegation
- MNES, India
- UK, DTI

WADE Membership – Current Members

Corporate members:

Capstone Turbines Corporation, USA
Caterpillar, USA
Centrax Gas Turbines, UK
Cummins Power Generation, USA
Enercon Engineering, USA
Energy Capital, Singapore
FuelCell Energy, USA
Marubeni Power International, Japan
Mitcon Consultancy Services Ltd, India
MTU CFC Solutions. Germany
Peter Brotherhood Ltd, UK
PT Lkaltimex Energi, Indonesia
Rolls-Royce Marine Engines, Norway
Saint-Gobain, France
Siemens, Germany
Solar Turbines, USA
Statoil, Norway
TEDOM, Czech Republic
Thermax, India
Wärtsilä, Finland

Association members:

Centre for Distributed Energy and Power, Australia
COGEN Europe, Belgium
COGEN India, India
COGEN Nederland, the Netherlands
COGEN Portugal, Portugal
COGEN Rio, Brazil
COGEN Sao Paulo, Brazil
Cogeneration Study Committee, China
Delta State Government, Nigeria
NewERA, Canada
UK CHP Association, UK
US CHP Association, USA

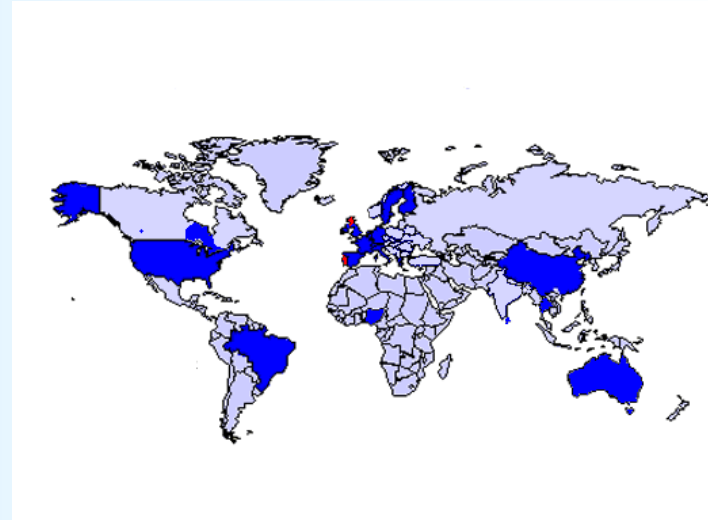
WADE Membership - Benefits

- Committee Membership
- Market Intelligence
- WADE Country Chapters
 - WADE China
 - WADE India
- Meetings and conferences
 - Discounted delegate fees
- Advocacy and public relations
 - Input on WADE consultation responses and advocacy activities
- Access to WADE global network
- Cogeneration and On-Site Power Production magazine
- WADE Newsletters

WADE Economic Model – Completed Applications

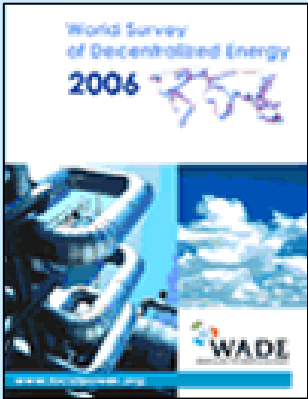
WADE would like to see model work replicated:

- In major cities
- In provinces/states
- In more countries

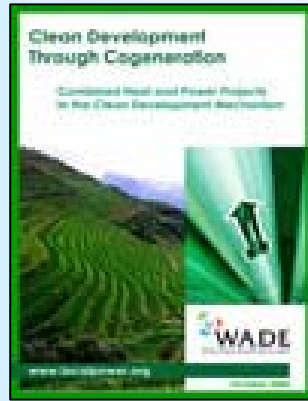


- **Australia** - Commonwealth Scientific and Industrial Research Organisation
- **Canada** - Federal Government of Canada (Natural Resources Canada)
- **China** - UK Government (Foreign Office), for China
- **EU** - European Commission – DG-FER programme
- **Ireland** - Government of Ireland (Sustainable Energy Ireland)
- **Sri Lanka** - European Commission
- **UK** - Greenpeace UK
- **Scotland** - Greenpeace UK
- **USA** - Primary Energy Inc.
- **City of Calgary**- Federal Government of Canada
- **Province of Ontario**- Federal Government of Canada
- **Iran** – Greenpeace International
- **Korea** - KEMCO
- **Utah** – (In the pipeline)
- **Germany** - (In the pipeline)

WADE Communications



Market Information



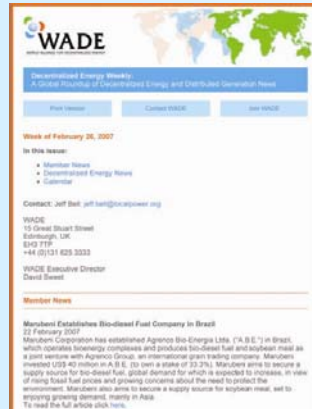
Research Reports



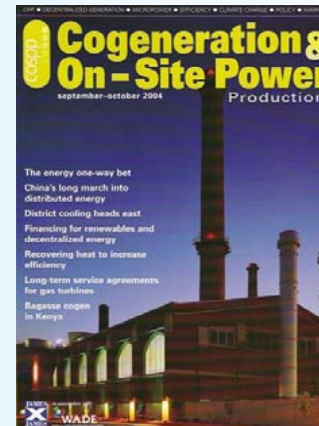
Website



Monthly Newsletter



Weekly Member Updates



COSPP Magazine



Local Power is a Global Solution

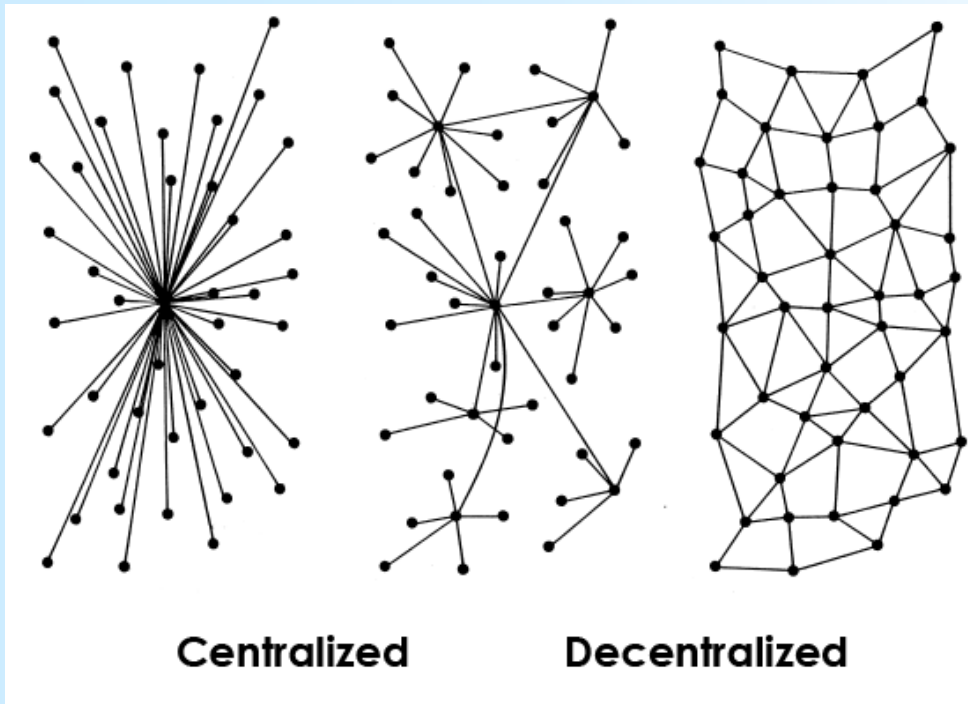
- DE technology is ready now
- DE can improve the environment and the bottom-line
- Energy prices and climate change will accelerate DE deployment worldwide
- Distributed technologies have led to major market shifts in other areas, such as computing and telecom

What is Decentralized Energy (DE)?

Electricity production *at the point of use*, irrespective of size, fuel or technology – on-grid or off-grid:

- High efficiency cogeneration (CHP)
- On-site renewable energy
- Industrial energy recycling and On-site power
- Otherwise known as:
 - CCHP (Combined Cooling Heat and Power), Distributed Generation, Captive Power, Embedded Generation, Microgeneration, CHP, Trigeneration, Recycling Energy, etc.

Decentralized Technologies



Computing:
Internet vs. Mainframes

Telecommunications:
Cell phones vs. land lines

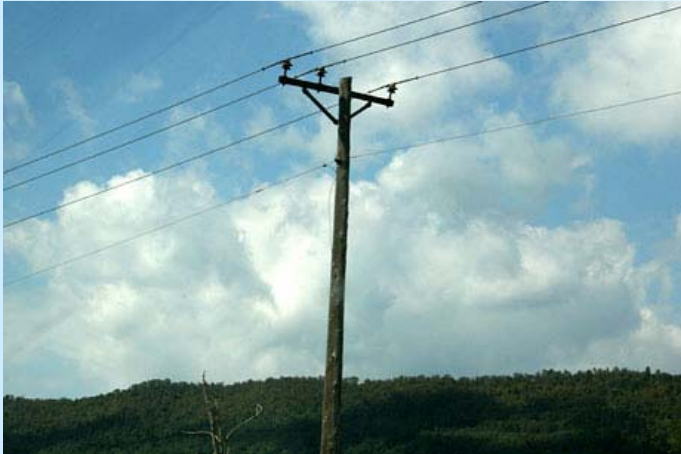
Broadcasting:
Television Eg. You Tube
Radio Eg. Podcasts

Electricity:
Decentralized energy
technologies

The Move to Decentralized Technology



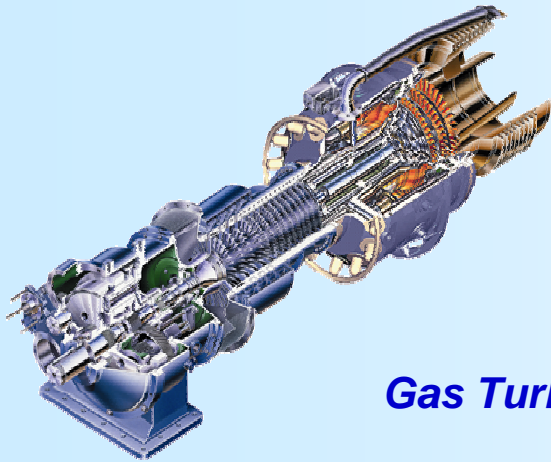
VS.



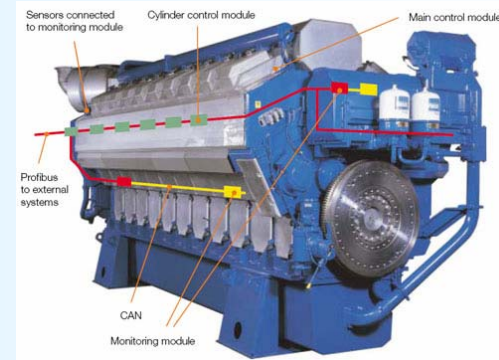
VS.



Decentralized Energy – Fossil-fuel Technologies



Gas Turbines



**Reciprocating Engines
Large & small**



Microturbines

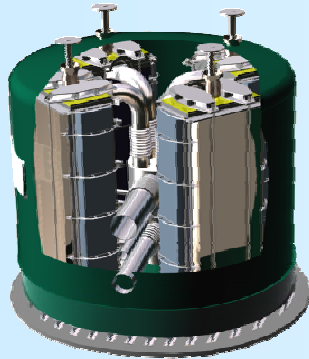


Steam Turbines



Stirling Engines

Decentralized Energy – Renewable Technologies



Fuel Cells



Biomass



On-site wind



Rayong Municipality cogeneration plant

Municipal Waste



Rooftop PV

WADE Outreach - G8

- 2007 G8 Declaration calls for the member nations to:
“Adopt instruments and measures to significantly increase the share of combined heat and power (CHP) in the generation of electricity.”

WADE Outreach - IPCC

- In the Intergovernmental Panel on Climate Change 4th Report on Climate Change Mitigation there is a section on “Decentralized Energy”.
- WADE work is cited in the report
- Benefits cited include:
 - Reduced need for costly transmission systems
 - Shorter lead times
 - Substantially reduced grid power losses
 - Deferred costs for upgrading transmission and distribution infrastructure
 - Improved reliability
 - Increased total energy recovery from 40–50% up to 70–85% with corresponding reductions in CO₂ emissions of 50% or more

Source: IPCC Fourth Assessment Report, Working Group III, Chapter 4 Energy Supply

WADE Outreach - DTI

- In the recent UK Energy White Paper there is a chapter on DE which calls for:
 - providing more flexible market and licensing arrangements for distributed, low carbon electricity supply to be implemented by 2008
 - greater clarity on the terms offered by energy suppliers to reward micro generators for the excess electricity they produce and want to export back to the grid
 - provision of information and advice to those individuals, communities and developers considering distributed energy solutions, and
 - incentives for Distributed Network Operators to ensure more efficient and speedy connection to networks
- WADE work is cited in the paper

Source: Energy White Paper 2007

DE and Climate Change - Asia Pacific Partnership

- Seen as key agreement for engaging those that have not yet ratified the Kyoto protocol as well as major developing countries who have not yet made targets under their Kyoto commitments
- Partnership of 6 countries
 1. Australia,
 2. China,
 3. India,
 4. Japan,
 5. Republic of Korea
 6. the United States

DS5

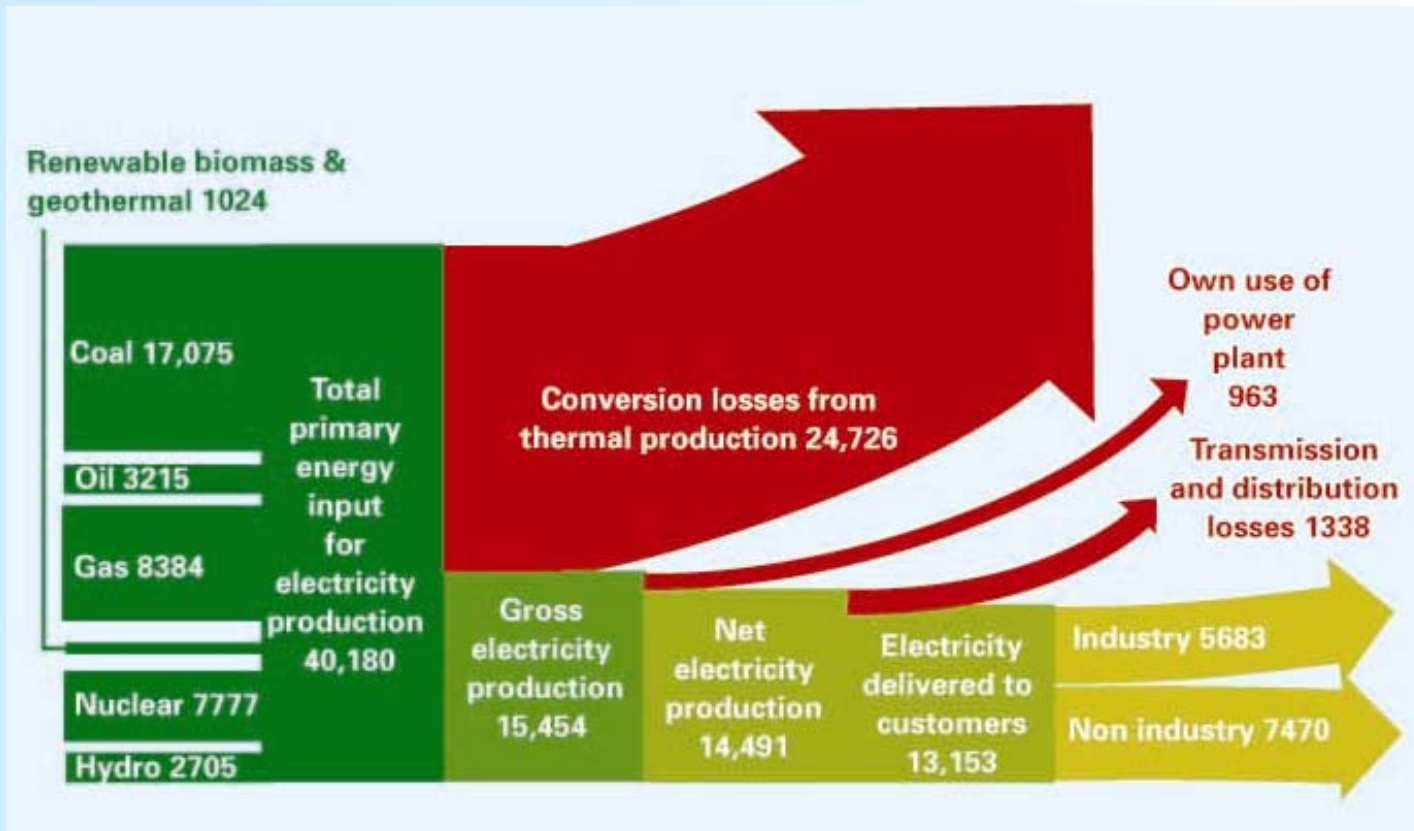
Why is DE better?

Benefits of DE compared to centralised generation

- DE is more efficient
- DE is cheaper
- DE is cleaner
- DE is more reliable
- DE is more secure
- DE provides access to electricity in remote areas
- DE can be sited quicker and with less opposition

Energy Madness – worldwide energy waste

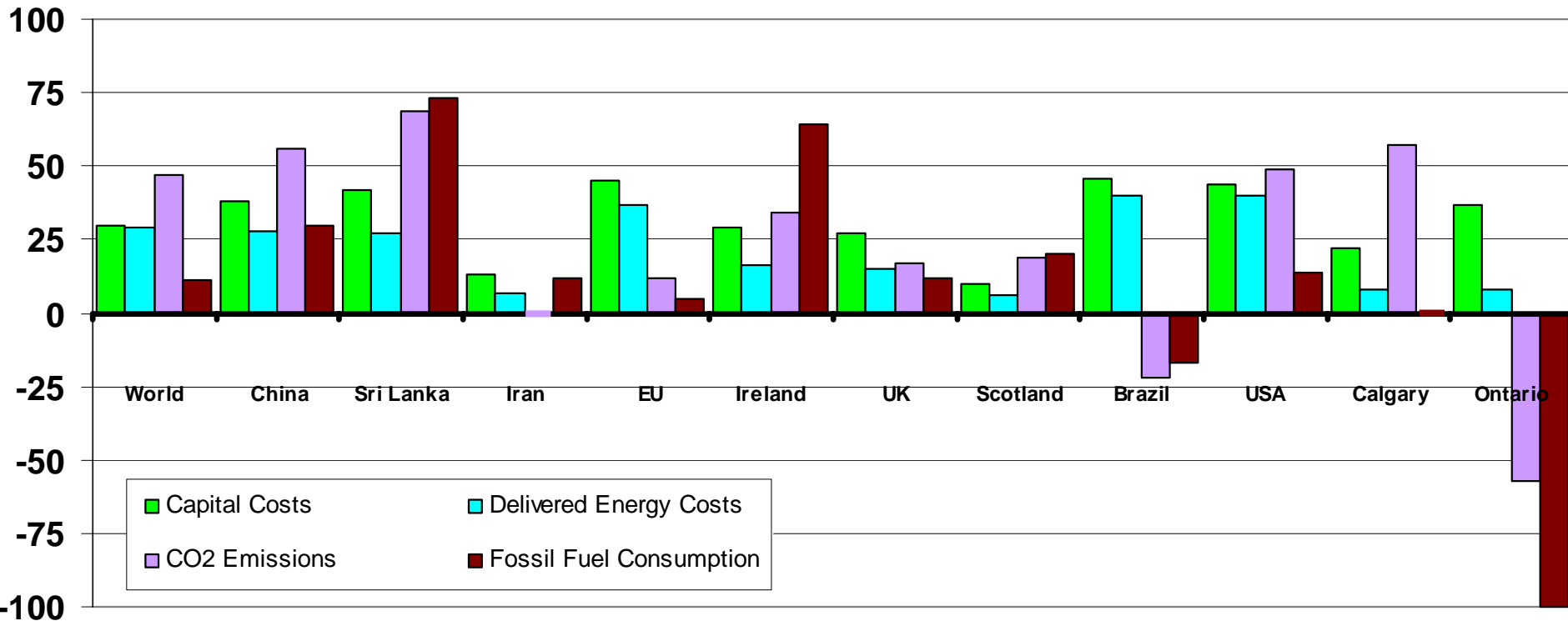
Electricity Generation Worldwide (TWh)



(Source: International Energy Agency 2002)

DE Benefits – WADE Economic Model – Selected Past Results

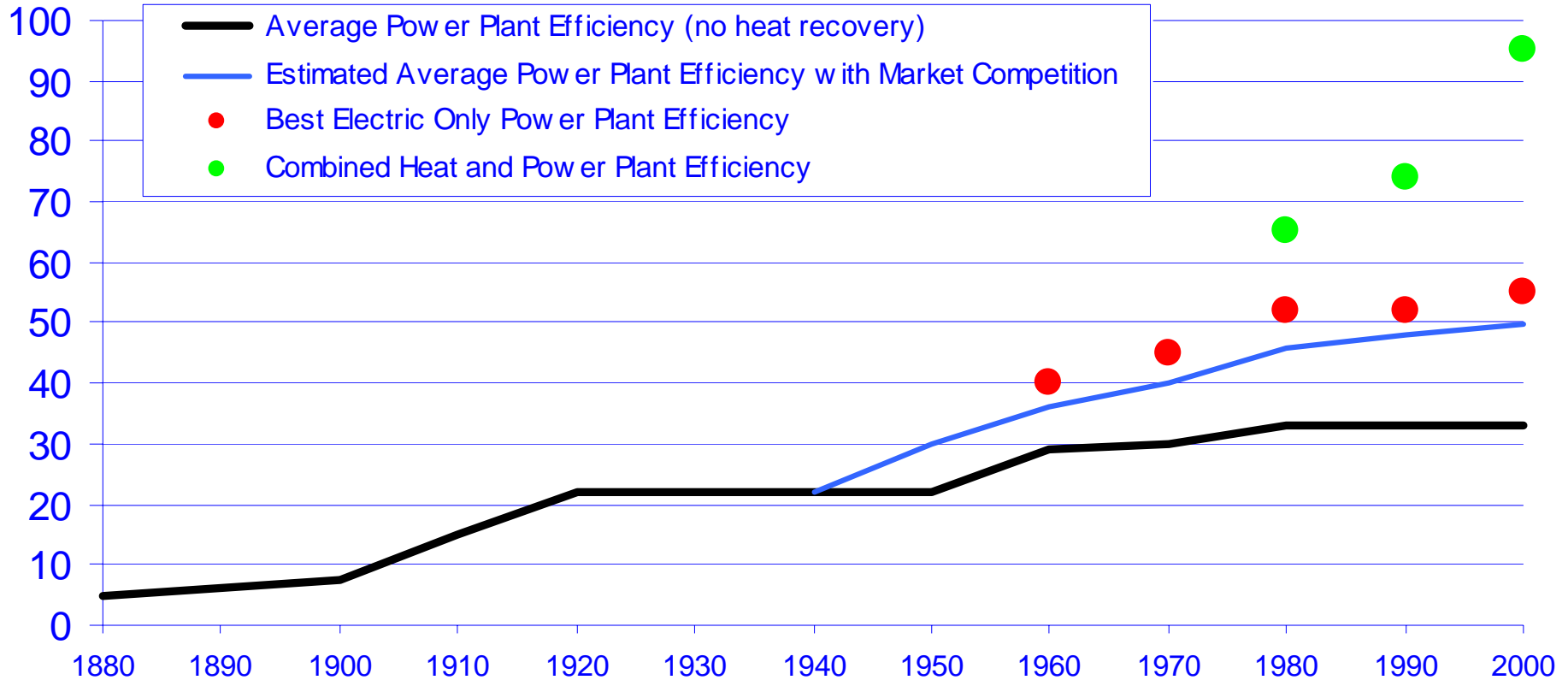
Estimated Total Savings (%) by Increasing Proportion of DE in New Power Sector Investments



(Source: WADE various)

Note: Proportion of total investment that is DE varies from region to region and from scenario to scenario- (ie in some cases savings are resultant from all new capacity being DE compared to baseline and in other cases only 25% of new capacity is DE compared to baseline)

Average Power Plant Efficiency (%) Over Time



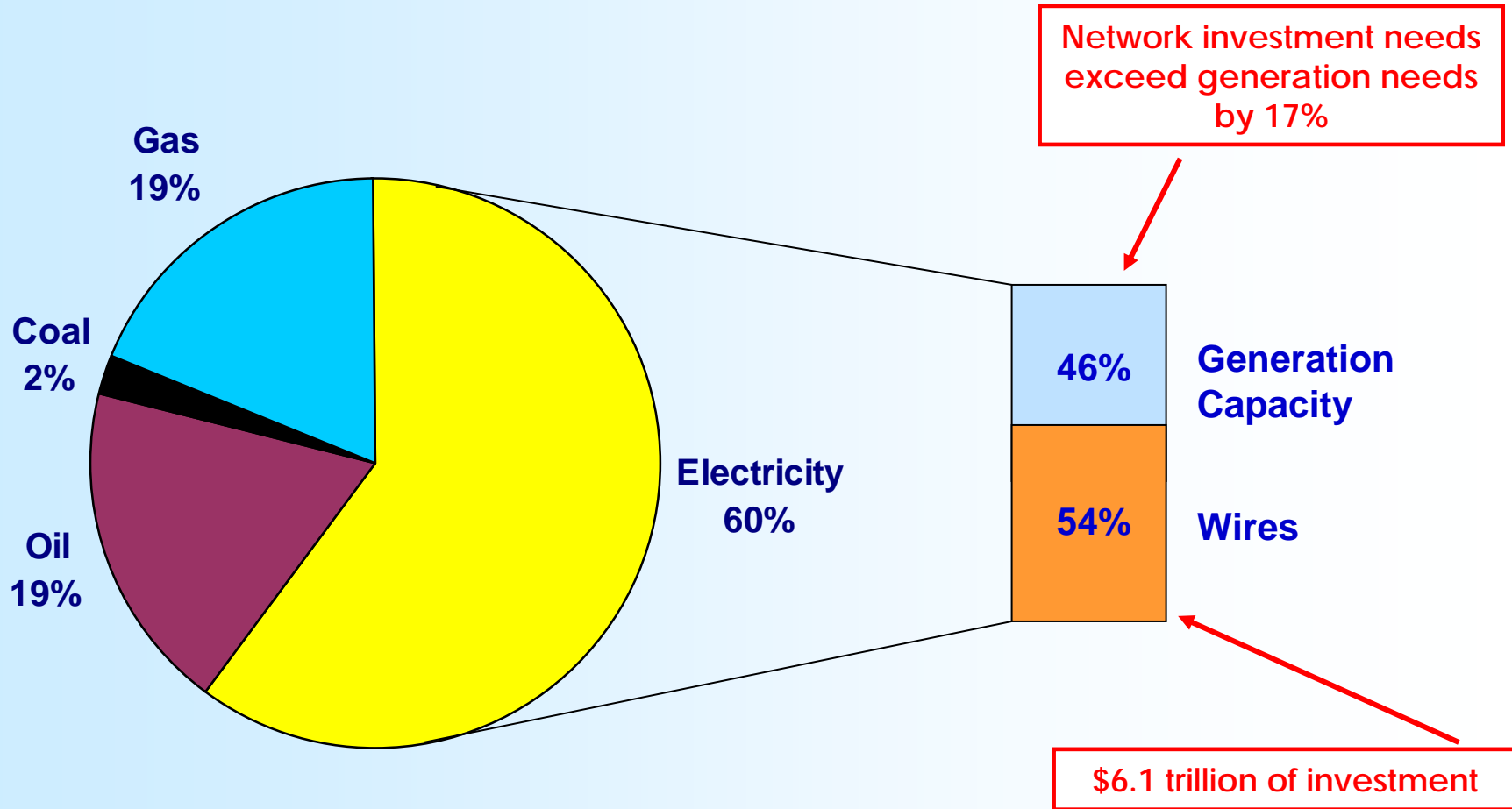
1957

vs

2007



World All-Energy Investment, 2001 - 2030



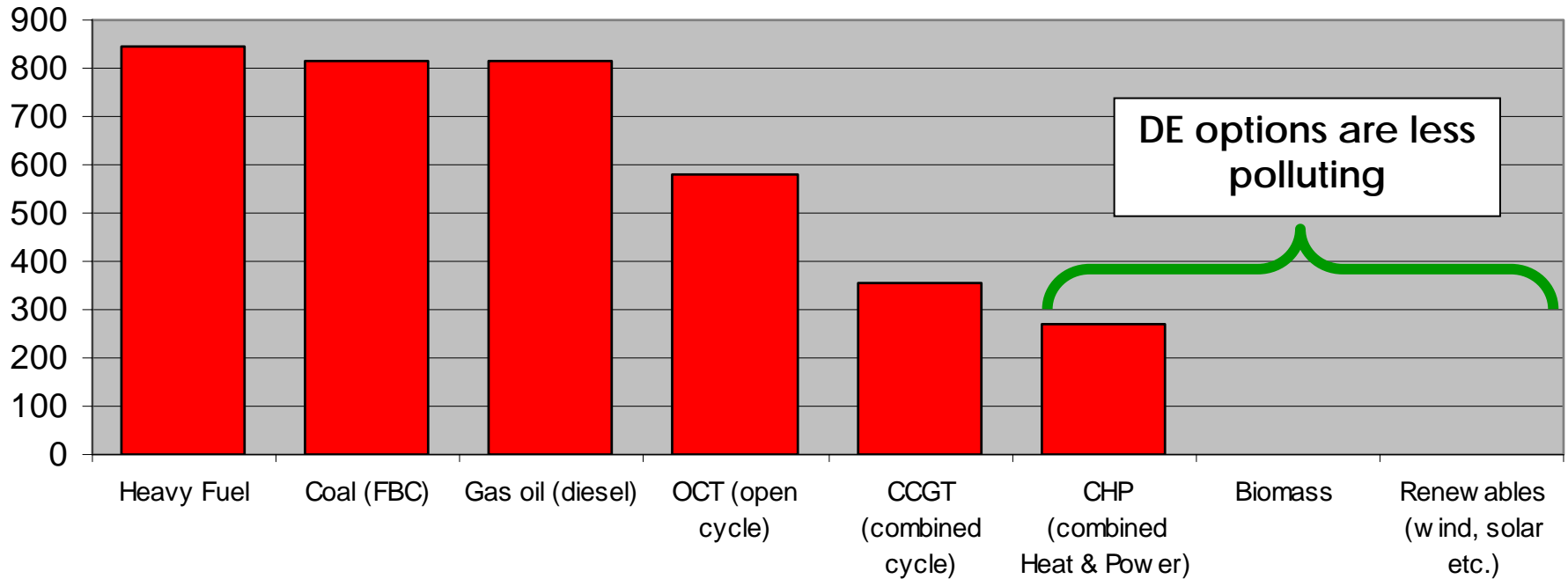
Source: IEA World Energy Outlook, 2006

Benefits: Climate Change



Benefits – Environmental

Fossil Fuel Emissions by Technology (kg CO₂/MWh)



Benefits - Cost Effectiveness of DE

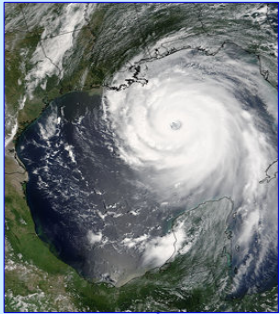
Effectiveness of subsidy mechanisms for CO₂ reduction of the Dutch Government	
Measure	Costs (€/t CO₂ saving)
CHP	25
Animal waste combustion	50
Co-combustion of biomass	75
Double glazing	160
High-efficiency domestic boilers	160
Home insulation	160
High-efficiency household appliances	160
Onshore wind power	200
Pure biomass	200
Solar boilers	250
Offshore wind power	250
Wave and tidal energy	250
Solar cells	250
Hybrid cars	1400

Source: RIVM/ECN, April 2004

DE Benefits – Reliability

August 29, 2005
Hurricane Katrina
Hits Jackson, MS

Mississippi Baptist Medical Center – Jackson MS



Hour 3
-Connection to
MPG Restored

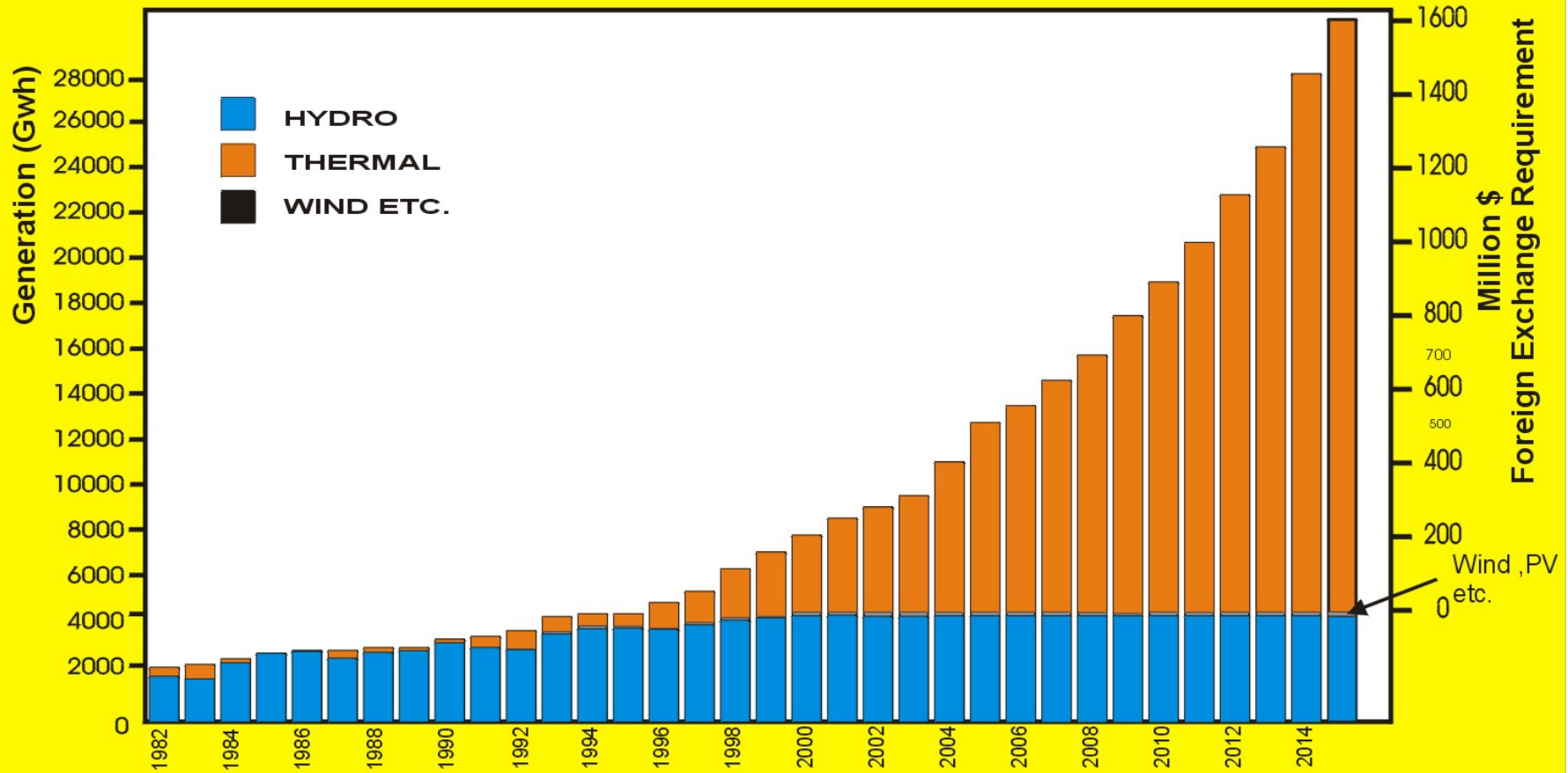
- 52 hrs of 100% operation on CHP
- Only Hospital in the Jackson Metro
Area to be Nearly 100% Operational

Hour 1
-Grid Fails
-Emergency Power
Grid Enabled
-City Water Lost

Hour 5
-Power Reliability Problems
-Switched to CHP Operation Only
-Elevators on Emergency Generators
-Restricted use of MRI Equipment

Hour 57
- Connection
to Grid
Restored

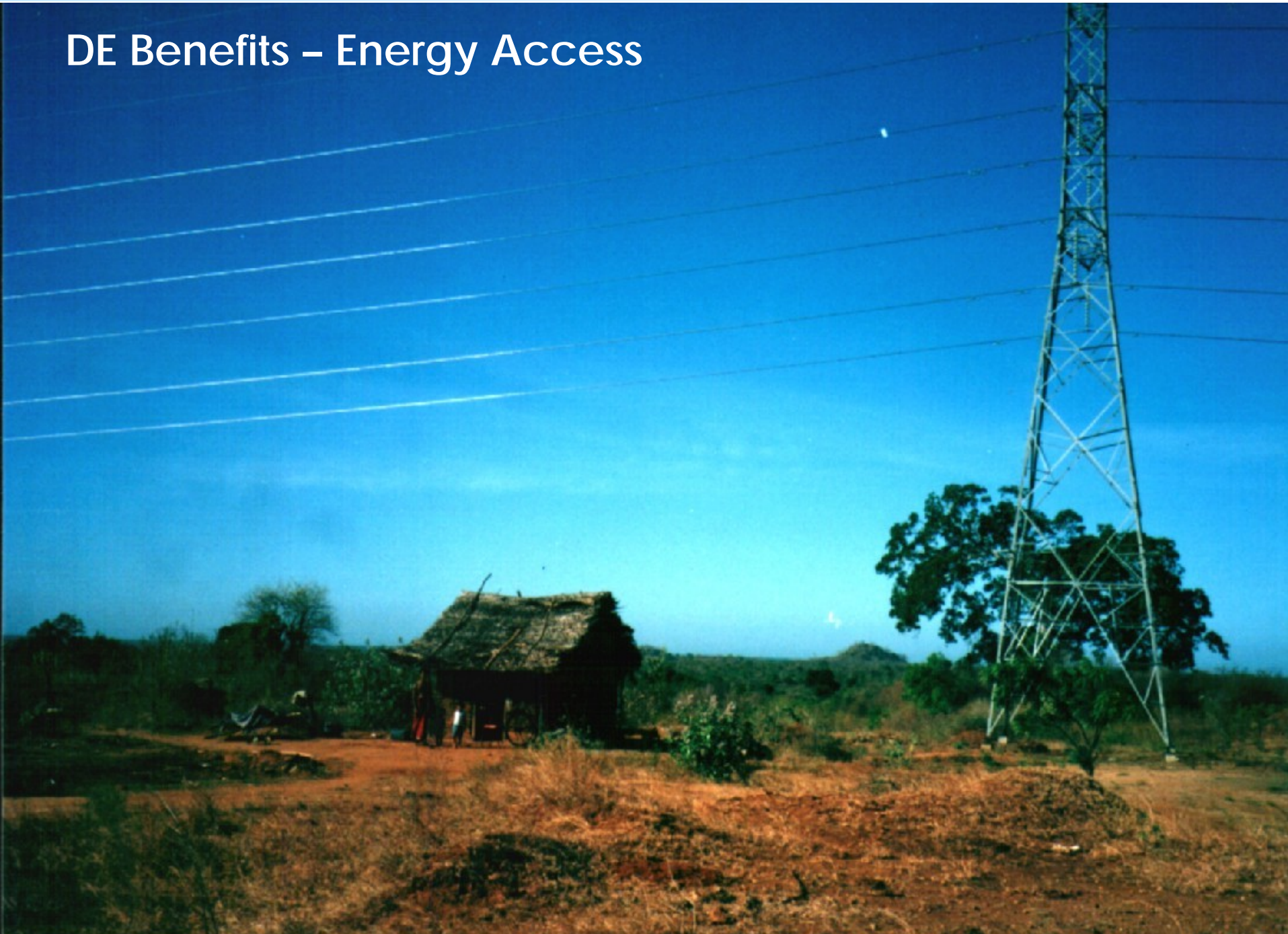
DE Benefits – Import Dependency and Energy Security



Sri Lanka: Fossil-fuel fired generation and fuel imports:

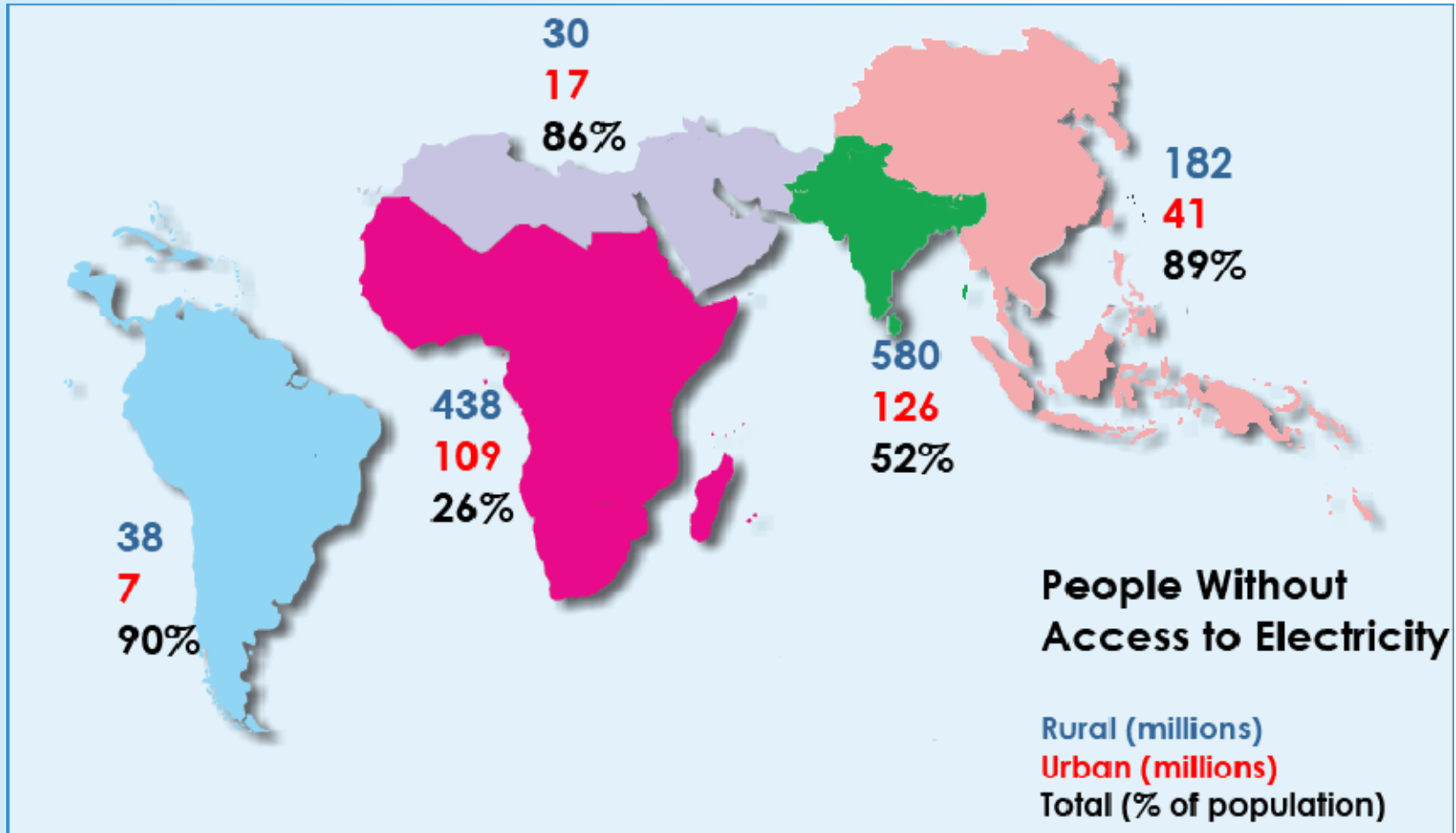
\$17 million foreign exchange per GWh

DE Benefits – Energy Access



DE Benefits - Access

Total population without electricity: 1.6 billion people (2005)

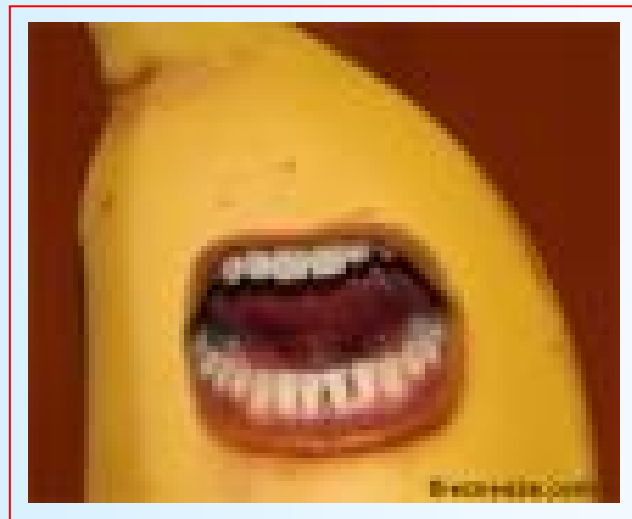


Source: IEA World Energy Outlook 2006

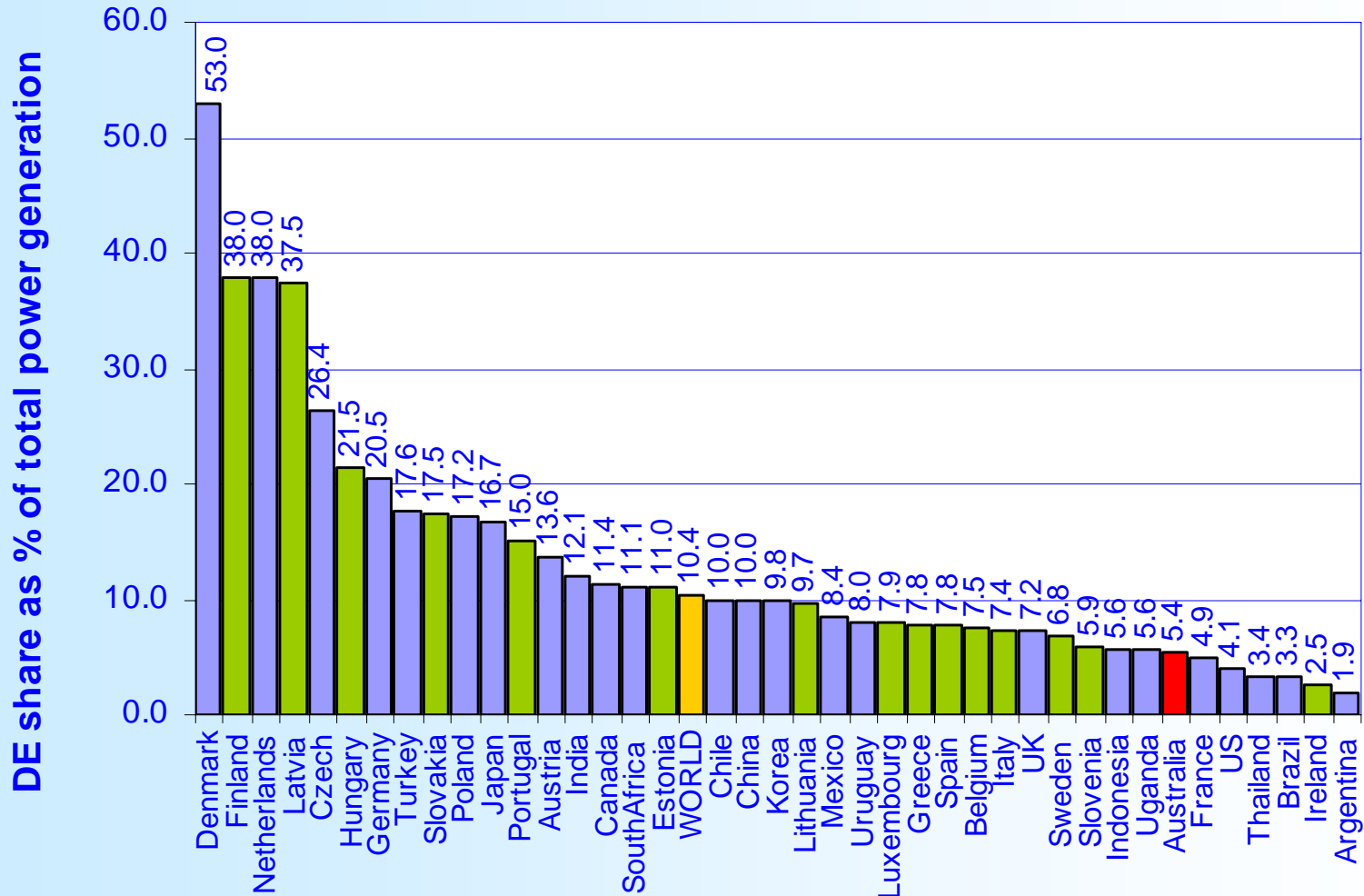
DE Benefits – Health and Quality of Life

Indicator of Human Welfare	Commercial Share of Total Energy		
	0-20 %	21-40 %	41-100 %
Life Expectancy (Years)	59.8	69.0	69.5
Probability of not surviving to 40	21.7	9.4	9.1
School Enrollment (%)	52.4	65.4	76.9
Children Underweight (%)	40.9	15.1	11.9
No Access to Clean Water (%)	20.9	22.8	12.8

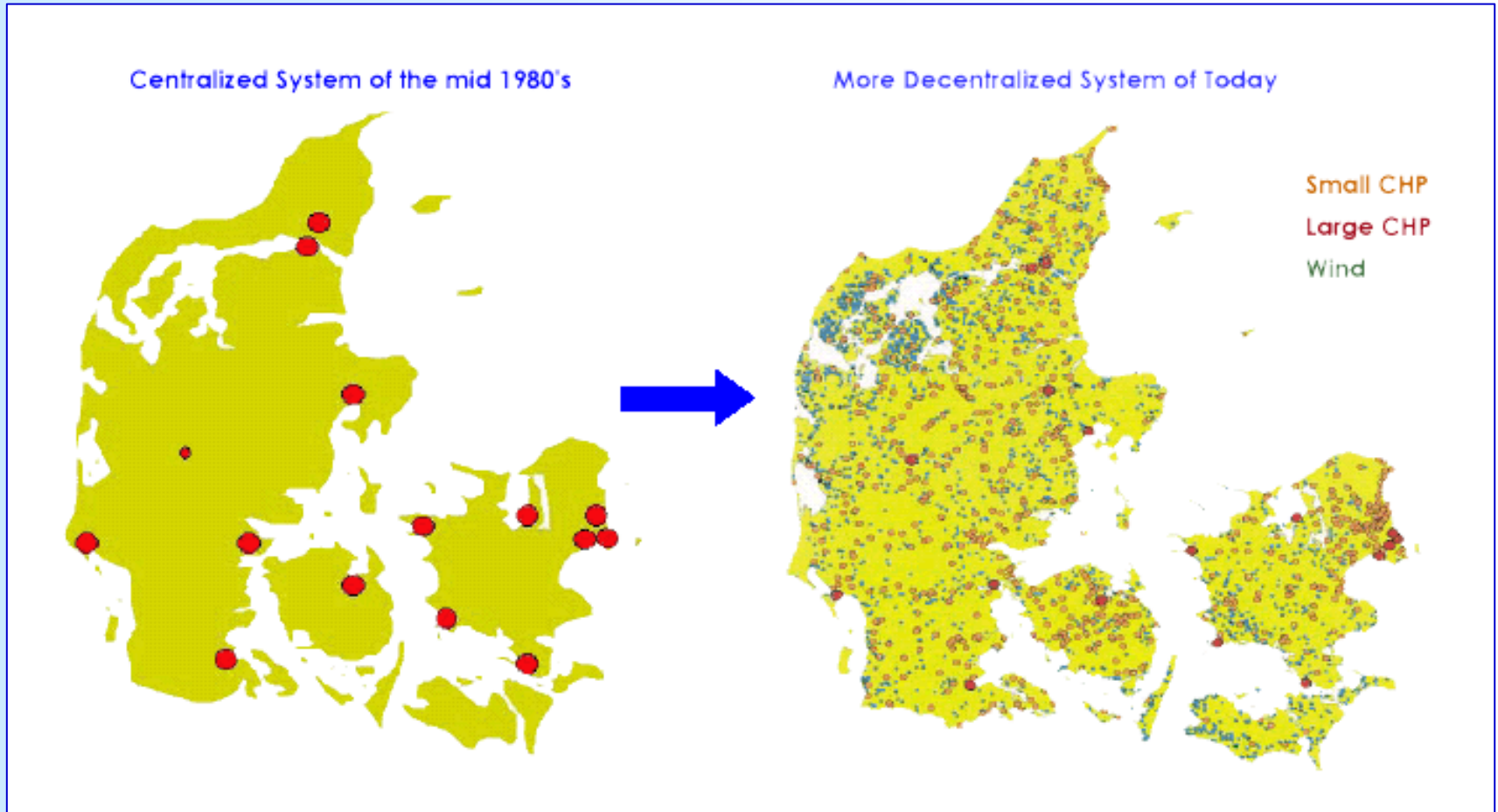
Transmission Siting Obstacles - NIMBY, BANANA and NOPE



DE around the World - Current Status

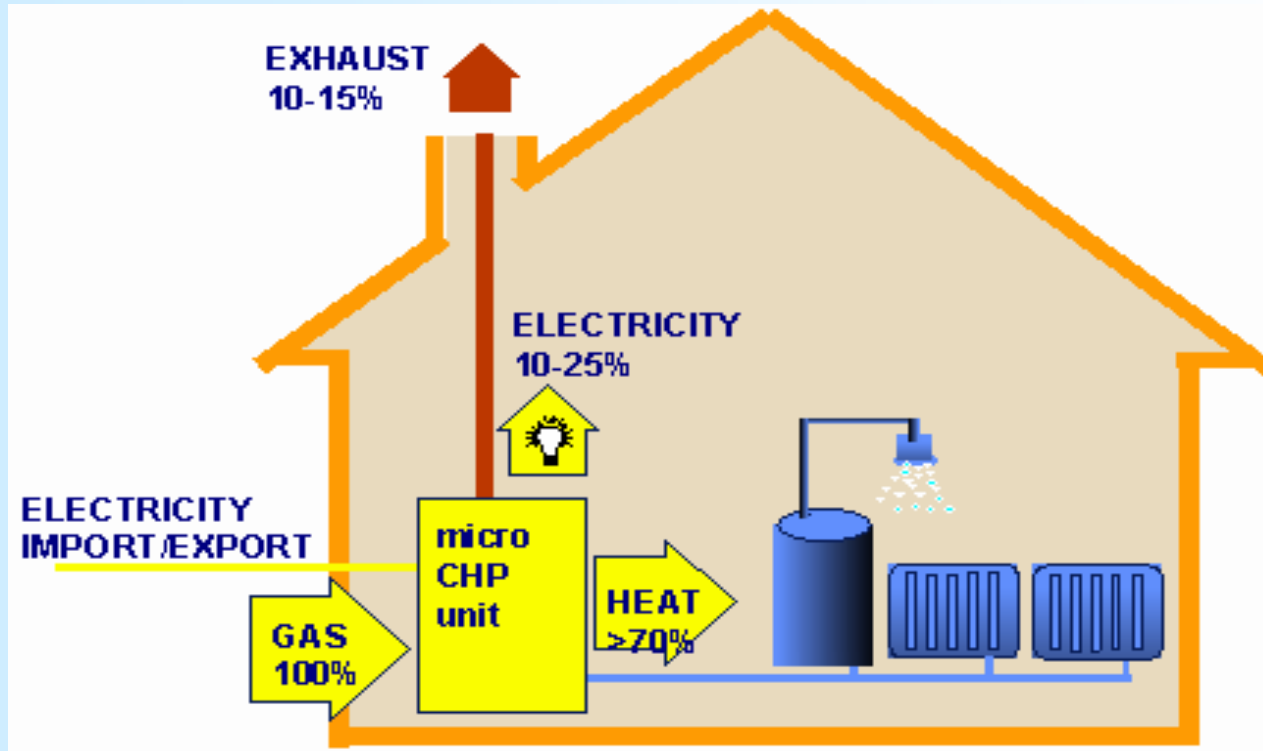


What is Possible for a Country



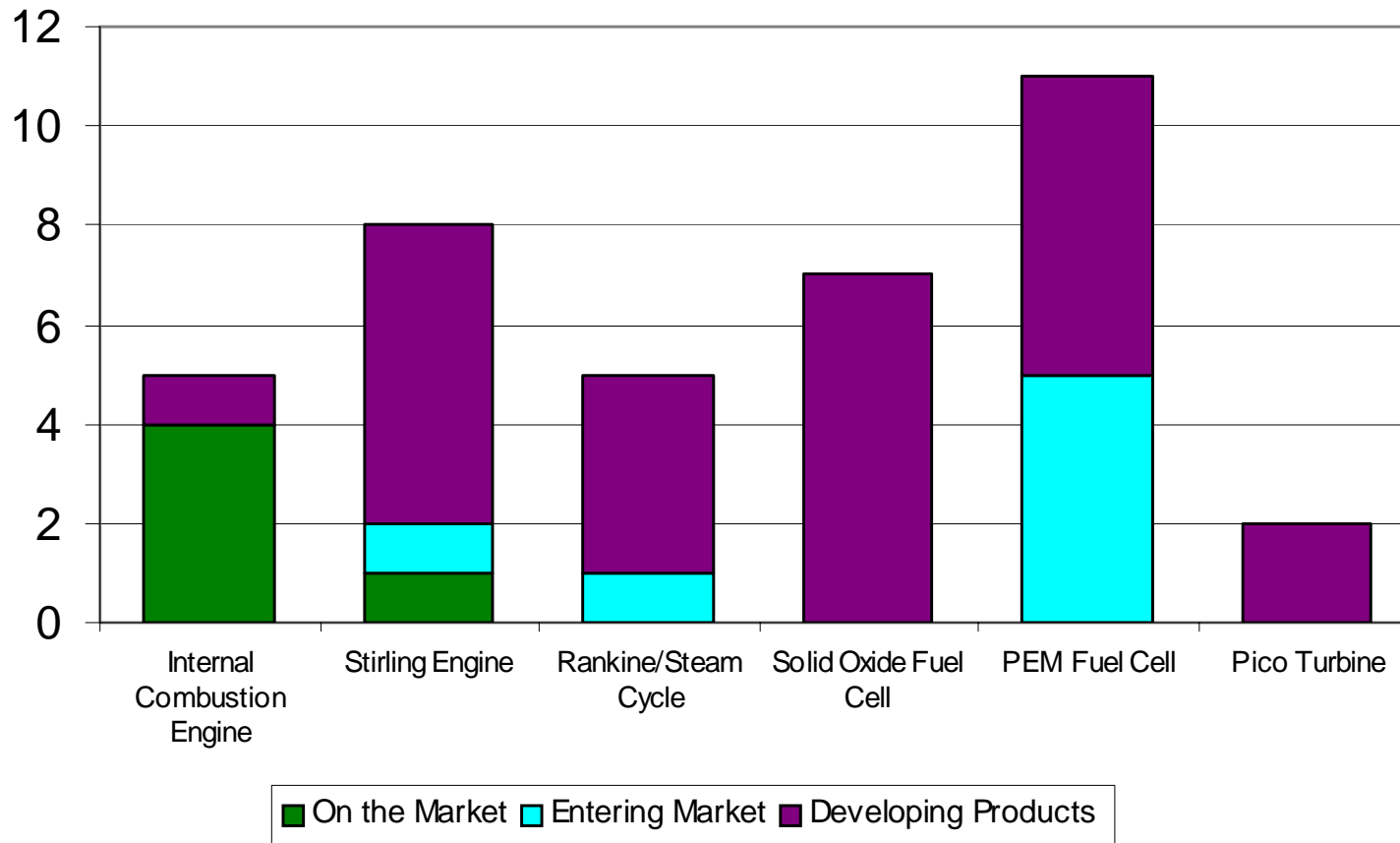
Source: Danish Energy Center

MicroCHP – the Concept



MicroCHP – The Technologies

Selected MicroCHP Developers in the European Market



MicroCHP - Examples



Dachs-
Reciprocating Engine
Electrical output: 5.3kWe
Thermal output: 10.4kWt
~Cost: £13000



Whispergen
Sterling Engine:
Electrical output: 1.2kWe
Thermal output: 8kWt
~Cost: £3000



Ecowill:
Reciprocating Engine
Electrical output: 1kWe
Thermal output: 3kWt
~Cost: £5600

Conclusions:

- DE is a win-win form of power generation;
- DE has great potential to reduce CO₂ emissions and reduce overall costs of supplying power;
- DE can provide energy access for those in rural areas and developing countries;
- Barriers tend to be policy barriers;
- Organizations like WADE can help breakdown barriers through advocacy and education.

Who knows what the future will bring?



Local Power is a Global Solution!

Thank you!

www.localpower.org

dsweet@localpower.org