

A GREEN ENERGY FUTURE

ENERGY SOLUTIONS 2011

CHARLES SECRETT

THE ROBERTSBRIDGE GROUP

t-mac
technologies
Energy Management Systems

UK Carbon Reduction Target 50% by 2025 (80% 2050) – EU Target 20% by 2030 w/ UK pressing for 30%

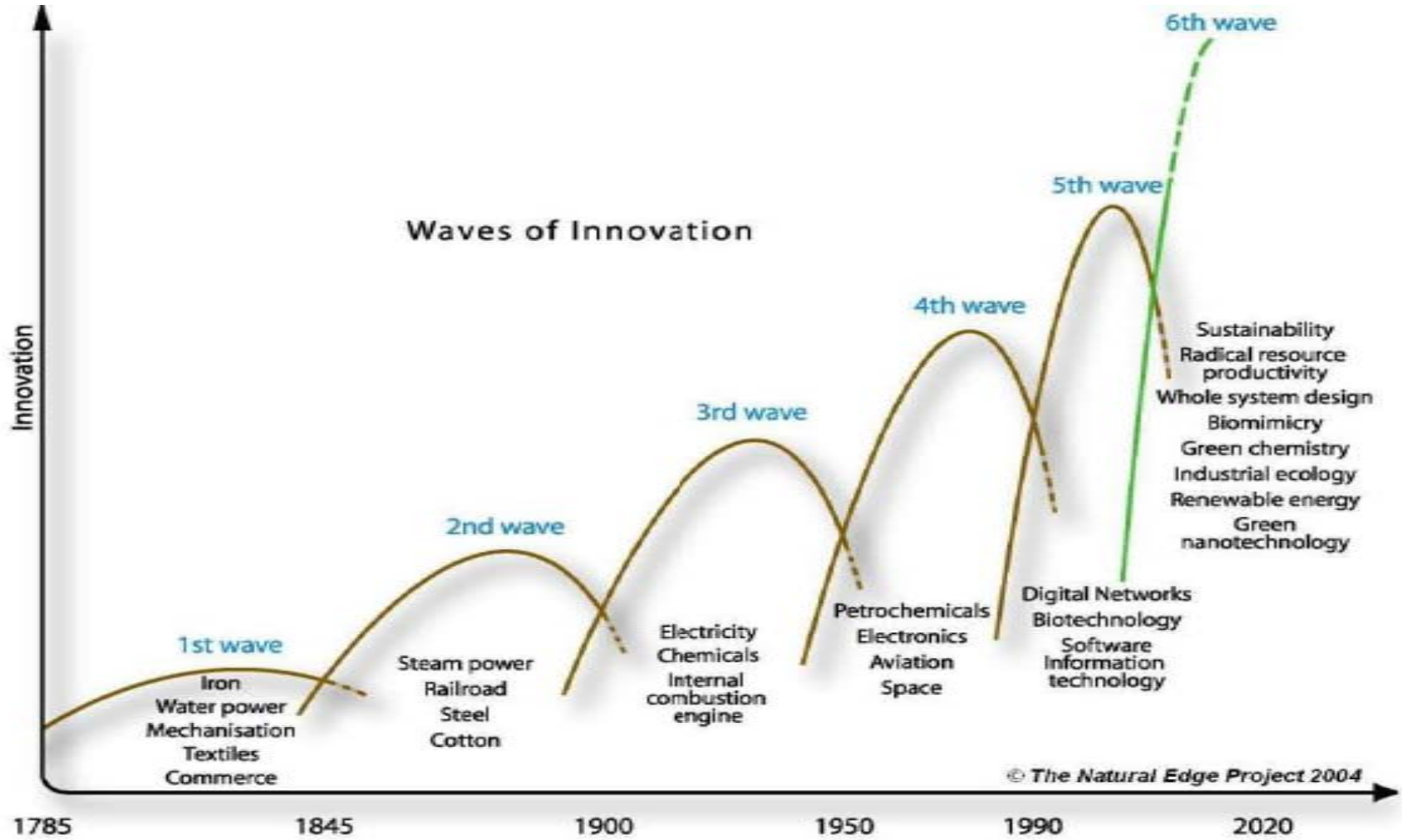
- **What is the best way to address climate change and energy security in the years and decades ahead?**
- **Does the UK need to develop new and longer-term policies for tackling climate change?**
- **Is enough being done on carbon reduction and energy efficiency?**
- **Are government programmes to save energy, reduce emissions and tackle climate change adding an acceptable layer of green taxation to energy users?**

Industrial History = innovation and crashes....

Peter Newman

Professor of Sustainability

Curtin University Sustainability Policy (CUSP) Institute



THE UK CLIMATE CHANGE COMMITTEE

The Renewable Energy Review (May 2011)

- Overall conclusion: scope for significant penetration of renewable energy to 2030 (e.g. up to 45% ie 680Twh, compared to 3% today). Higher levels to 2050 technically feasible.
- Or, possible to decarbonise electricity generation with **very significant nuclear deployment** and have limited renewables
- **Carbon capture and storage** emerges as a cost-effective technology.
- Optimal policy is to pursue a portfolio approach. Renewable technologies such as offshore wind and marine require the resolution of current uncertainties and cost reductions.
- Therefore: new policies are required to support technology innovation and to address barriers to uptake in order to suitably develop renewables as an option for future decarbonisation.

ELECTRICITY MARKET REFORM

JULY 2011 WHITE PAPER

Reform of UK electricity market is coalition's chief weapon for cutting UK G/G emissions.

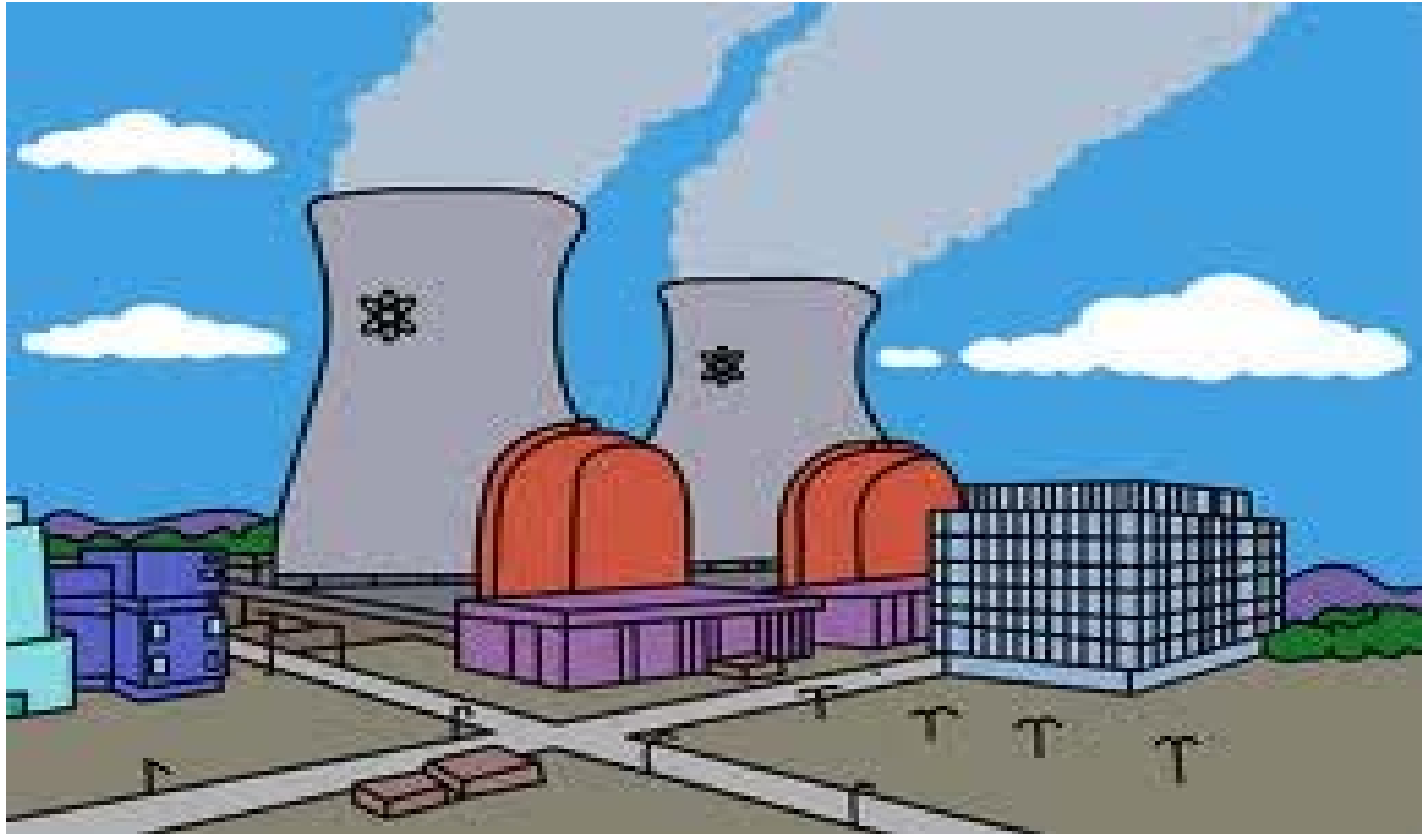
EMR 4 major objectives:

- **a carbon price floor price**
- **a feed-in tariff (FIT) for all low-carbon and zero-carbon generators**
- **an emissions performance standard limiting CO₂ emissions from fossil-fuel power stations**
- **And, a 'capacity mechanism'.**

UK NUCLEAR PLANT

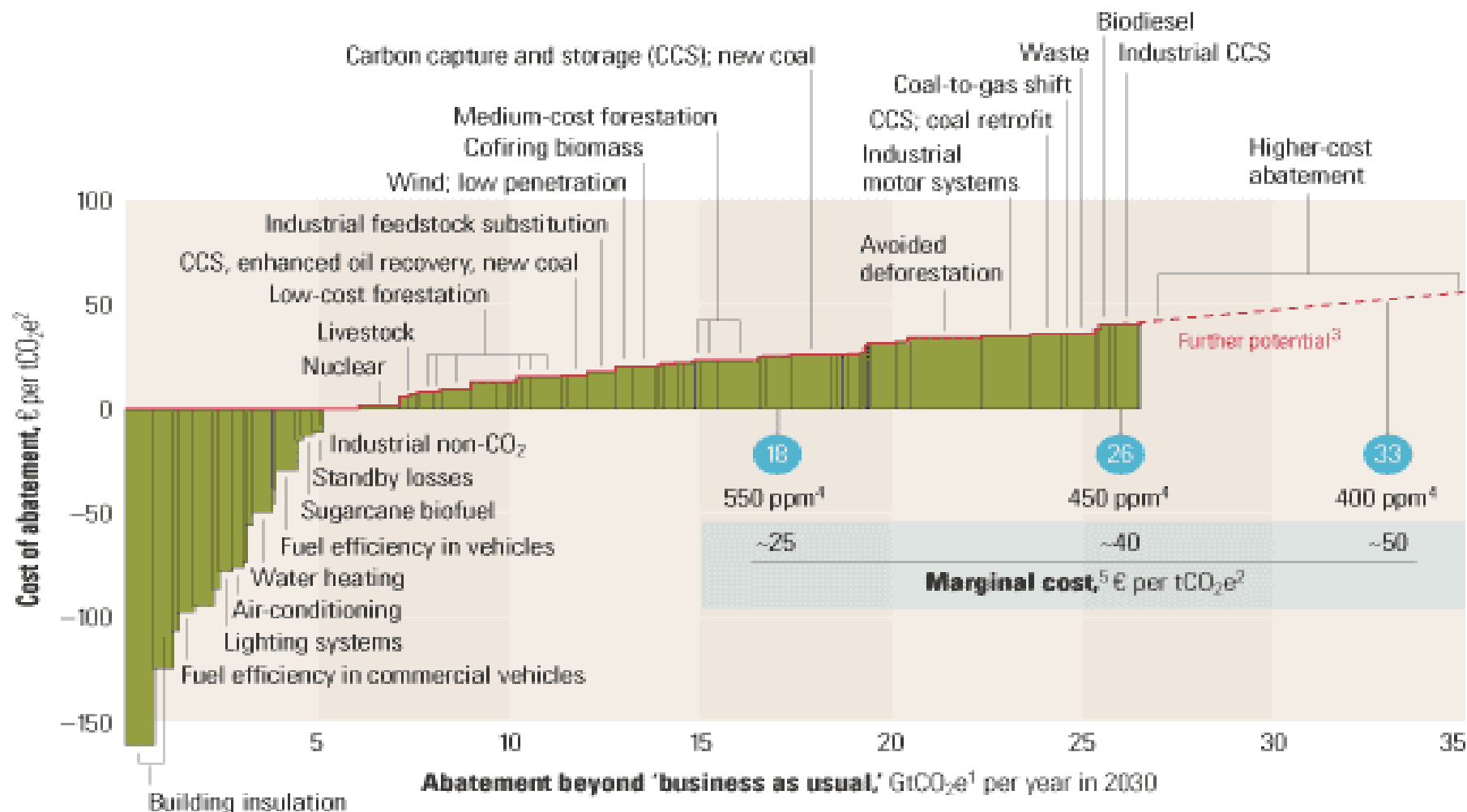


SPRINGFIELD NUCLEAR POWER PLANT



Global cost curve for greenhouse gas abatement measures beyond 'business as usual'; greenhouse gases measured in GtCO₂e¹

● Approximate abatement required beyond 'business as usual,' 2030



¹GtCO₂e = gigaton of carbon dioxide equivalent; "business as usual" based on emissions growth driven mainly by increasing demand for energy and transport around the world and by tropical deforestation.

²tCO₂e = ton of carbon dioxide equivalent.

³Measures costing more than €40 a ton were not the focus of this study.

⁴Atmospheric concentration of all greenhouse gases recalculated into CO₂ equivalents; ppm = parts per million.

⁵Marginal cost of avoiding emissions of 1 ton of CO₂ equivalents in each abatement demand scenario.

MCKINSEY CONCLUSIONS

- At the low end of the curve are, for the most part, measures that improve energy efficiency. These measures, such as better insulation in new buildings, thus reduce emissions by lowering demand for power. SAVE MONEY TWICE.
- Higher up the cost curve are approaches for adopting more greenhouse gas-efficient technologies (such as wind power and carbon capture and storage) in power generation and manufacturing industry and for shifting to cleaner industrial processes.
- Strong correlation between economic growth and the ability to implement low-cost measures to reduce emissions, for it is cheaper to apply clean or energy-efficient technologies when building a new power plant, house, or car than to retrofit an old one.
- Finally, in a 2030 perspective, almost three-quarters of the potential to reduce emissions comes from measures that are either independent of technology or rely on mature rather than new technologies.

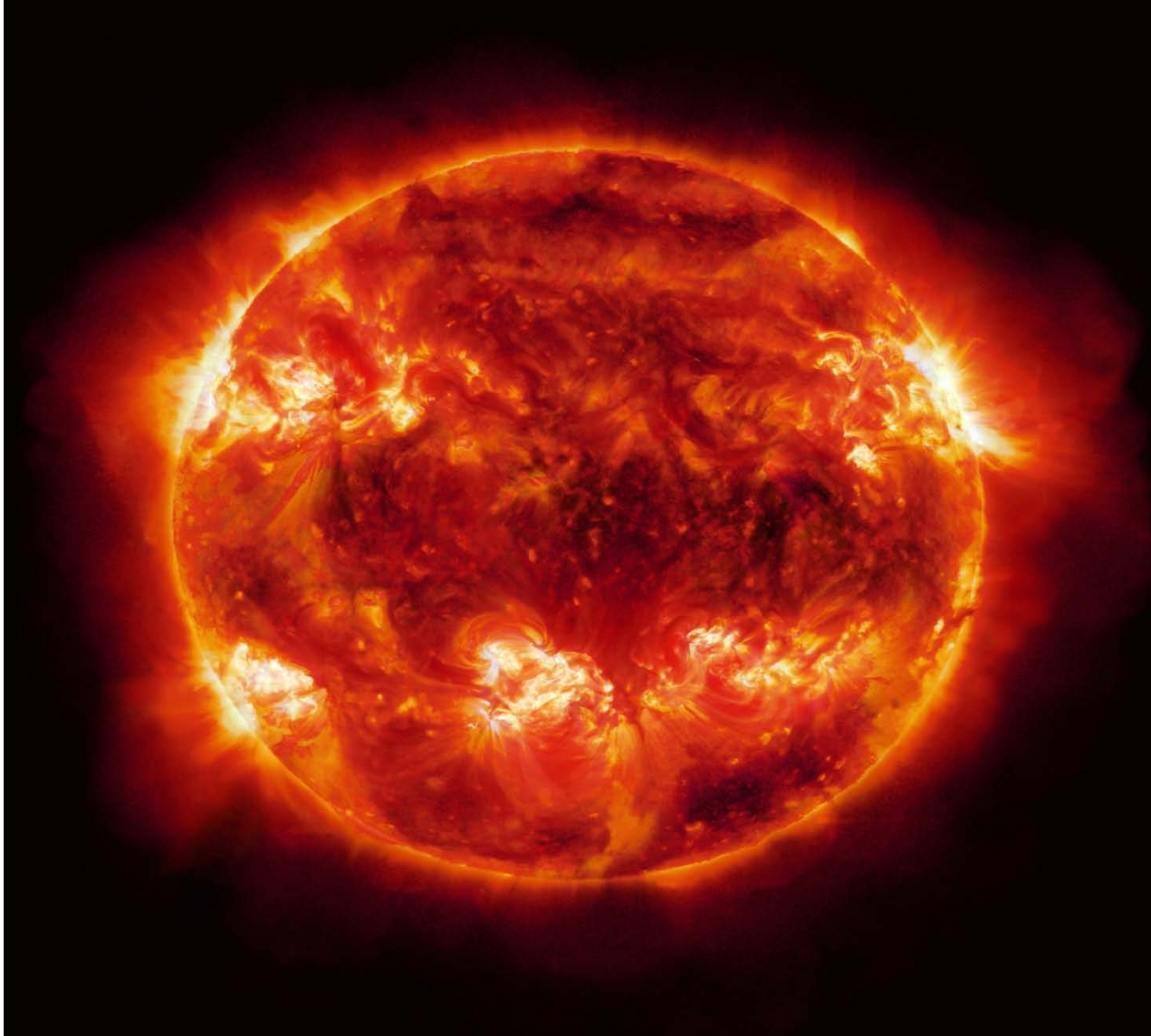
Cost-conscious regulation

1. Ensure strict technical standards and rules for the energy efficiency of buildings and vehicles
2. Establish stable long-term incentives to encourage power producers and industrial companies to develop and deploy greenhouse gas-efficient technologies
3. Provide sufficient incentives and support to improve the cost efficiency of selected key technologies, including carbon capture and storage
- (4. Ensure that the potential in forestry and agriculture is addressed, primarily in developing countries and closely linked to their overall development agenda)

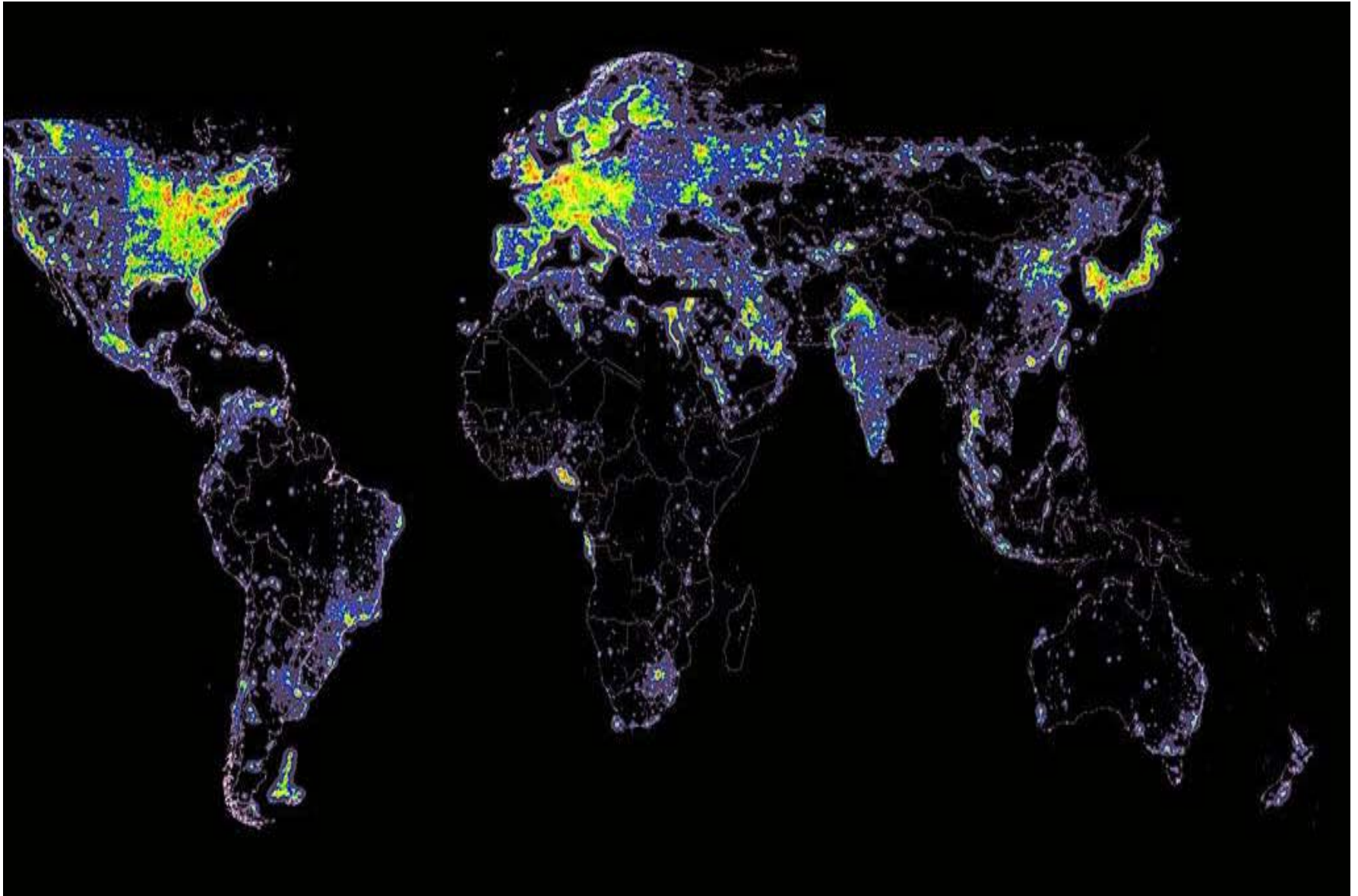
A cost curve for greenhouse gas reduction - A global study of the size and cost of measures to reduce greenhouse gas emissions yields important insights for businesses and policy makers.

February 2007 • Per-Anders Enkvist, Tomas Nauc ler, and Jerker Rosander McKinsey Quarterly

CLEAN, SAFE, GROWING RAPIDLY, GETTING CHEAPER
NUCLEAR POWER = SOLAR



Cities = 75% CO₂ emissions + 75% resource use



Cheaper and more efficient: decentralised energy – E/E, CHP, Micro-Renewables - London: from c.1% now to 25% of electricity supply by 2025



25-35 per cent of energy input used

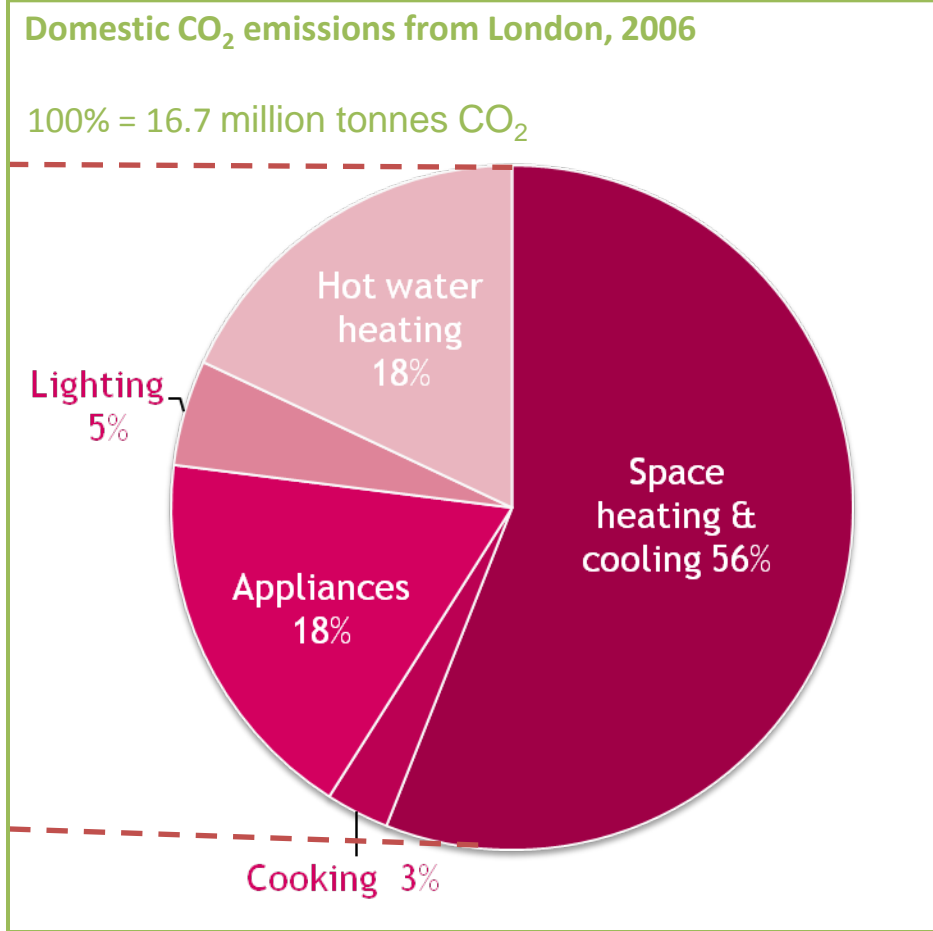
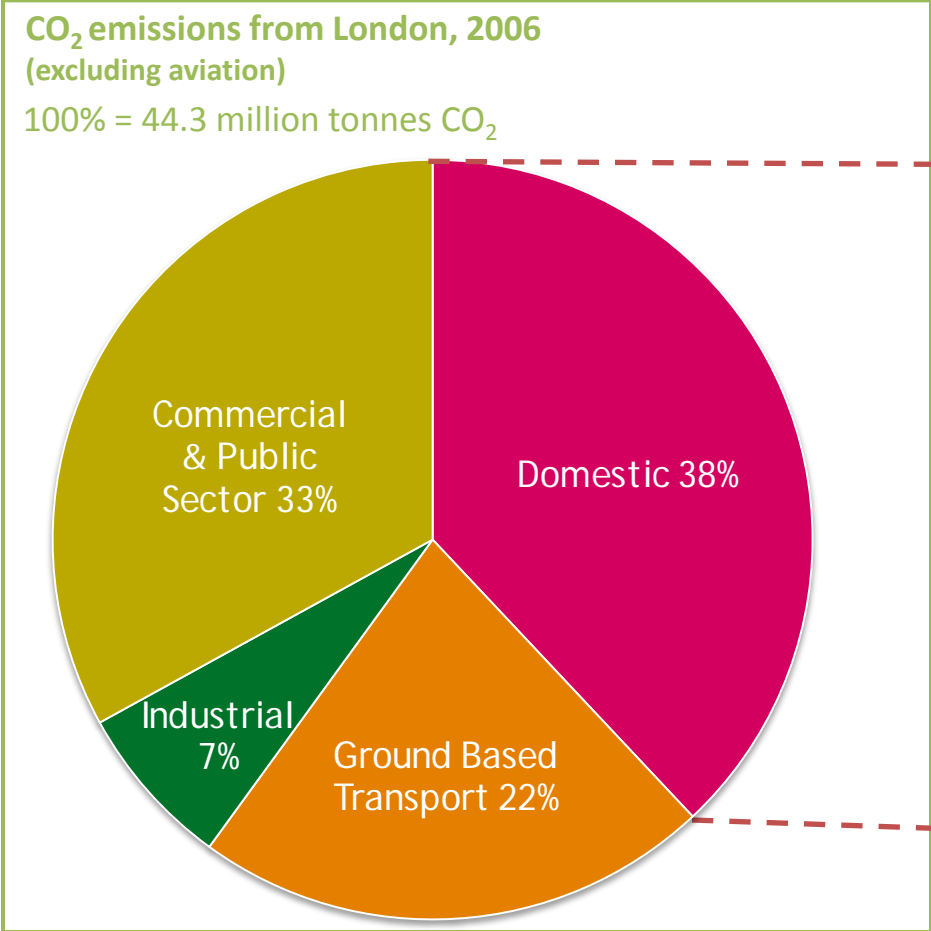


85-95 per cent of energy input used





Energy use in existing homes is the largest single source of CO₂ emissions in London

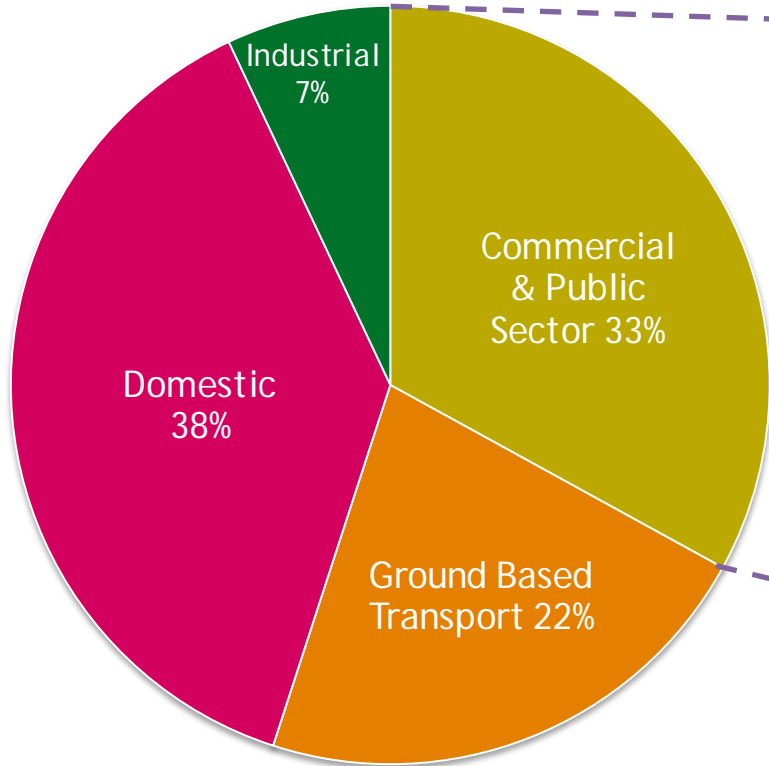


38% of London's total CO₂ emissions are from domestic housing. Almost three quarters of this is from space and water heating.

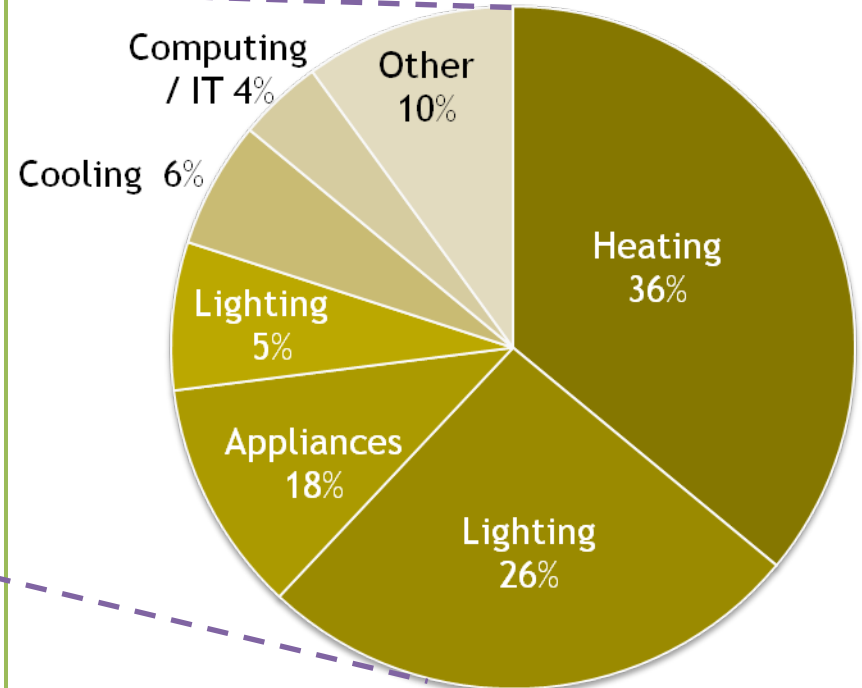
Source: London Energy and CO₂ Emissions Inventory; DEFRA

Energy use in commercial & public sector buildings is the second largest source of CO2 emissions in London

CO₂ emissions from London, 2006
(excluding aviation)
100% = 44.3 million tonnes CO₂



Commercial & Public Sector* CO₂ emissions from London, 2006
100% = 14.6 million tonnes CO₂



*Public sector: Health 23%, Education 47%, Offices 30%.

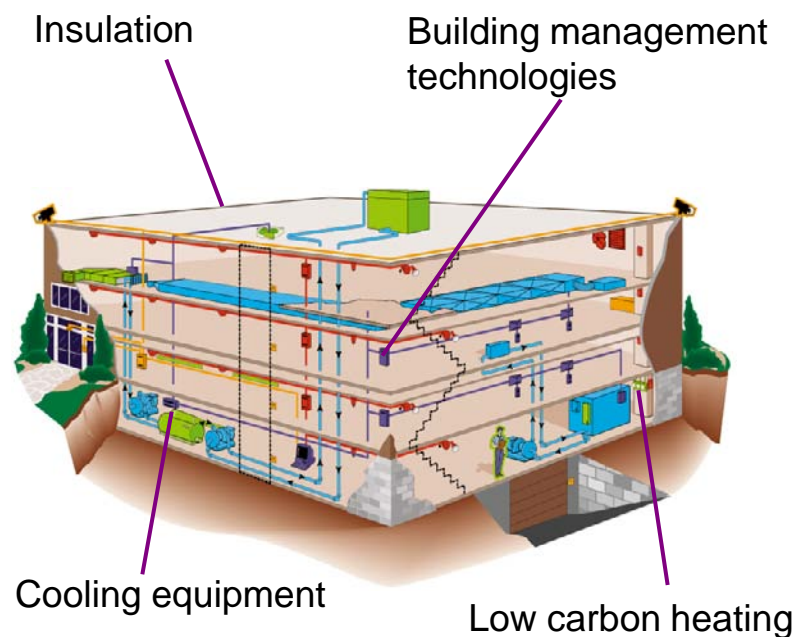
33% of London's total CO2 emissions are from Commercial & Public Sector buildings. Over one third of this is from heating.

Building Energy Efficiency Programme

- A cost effective way to reduce energy bills and carbon footprint of buildings

• Energy service companies (ESCOs) guarantee a set level of energy savings - therefore financial saving - over a period of years

• This guarantees a future income stream to fund investment in improvements



If all municipal buildings, schools, universities and hospitals were retrofitted, could save 1m tonnes CO₂, tens of millions of pounds in energy costs and represents 2% of London's CO₂ emissions

LONDON LOW COST E/E FUNDING

- **Councils, police, hospitals and fire services in London will be able to take out low-cost loans from a new £100m fund to improve the energy efficiency of their buildings from October 2011.**
- The London Energy Efficiency Fund will handle £50m of public money including support from the London Development Agency (LDA) and European Regional Development Fund.
- The Royal Bank of Scotland will supply the balance, with loans paid back through energy bill savings.
- **Eligible measures include more efficient lighting systems, ventilation and boiler upgrades, smart meters and solar panels.** Public buildings are responsible for around 10% of London's carbon footprint.

WARM FRONT

- **Nearly 130,000 households were upgraded through the Warm Front home energy efficiency scheme in 2010/11, delivering an average CO₂ emissions reduction of 20%.**
- **Warm Front targets low-income households in fuel poverty. In 2010/11, 105,171 households received efficiency measures related to heating, while 36,101 received insulation-related measures.**
- **The scheme delivered an average improvement in energy performance rating under the Standard Assessment Procedure (SAP) of 27 points and potential to cut fuel bills by £610 p.a. In 2010/11 were boiler replacements (76,227), loft insulation (20,385) and heating repairs (12,199).**
- **DECC has extended the scheme for two years. 2010/11 budget cut by two thirds to £110m; cut further in 2011/12 to £100m. From 2012, it will be superseded by the Green Deal domestic energy efficiency upgrade scheme and a new Energy Company Obligation on utilities.**

UTILITIES E/E PERFORMANCE

- **The 'big six' energy firms have been ordered to double the rate of homes being fitted with improved insulation** = Energy secretary Chris Huhne's warning followed a progress report on the Carbon Emissions Reduction Target (CERT) and data on home insulation levels by DECC, the energy and climate department.
- CERT requires the firms – Centrica, EDF, Eon, Npower, Scottish Power, and Scottish and Southern – to improve home energy efficiency. They face **finances of up to 10% of turnover if they fail to comply.**
- They must achieve a total reduction of 293 million tonnes of CO₂ by December 2012. The companies are **68% of the way through the programme, and so far 71% of the target has been achieved.**
- The government increased the target from 185MtCO₂ in July 2010. **Two thirds of the increase must be professionally installed insulation measures.**
- Some **3.5 million homes are set to benefit.** But energy firms will have to double installation rate from an average of 100,000 homes per month to 200,000 to achieve it.

APPLIANCES – BIG FRIDGES, BIG TVS, BIGGER EVERYTHING INC. ENERGY USE



Simple, beneficial emission cuts – why doesn't everyone do?!



Simple behavioural change by all Londoners could reduce **CO₂** emissions by 2.3 million tonnes and cut fuel bills



If all light bulbs were energy efficient, London would save 575,000 tonnes of **CO₂** and £139 million per year (2006 prices)



Major reductions from home insulation and **help solve fuel-poverty** in 4-500,000 homes in London

Changing **carbon-heavy behaviour** means
changing ...

- **Values**
- **Attitudes**
- **Beliefs**

- **BUT, ABOVE ALL, MARKETS**

The biggest block to behaviour change

**As long as it is cheap, convenient and legal to waste carbon and natural resources, then that is what the great majority of individuals, households and companies will do ...
at work, home and play.**

**CARBON AND RESOURCE WASTE PRICING
ESSENTIAL**

I.C.T. - Learning to be S.M.A.R.T.

SMART 2020: Enabling the low carbon economy in the information age



“The challenge of climate change presents an opportunity for ICT to:

- **Standardise (S)** how energy consumption and emissions information can be traced across different processes beyond the ICT sector’s own products and services
- It can **monitor (M)** energy consumption and emissions across the economy in real time, providing the data needed to optimise for energy efficiency
- Network tools can be developed that allow **accountability (A)** for energy consumption and emissions alongside other key business priorities
- This information can be used to **rethink (R)** how we should live, learn, play and work in a low carbon economy, initially by optimising efficiency, but also by providing viable low cost alternatives to high carbon activities. Although isolated efficiency gains do have an impact, ultimately it will be a platform – or a set of technologies and architectures – working coherently together, that will have the greatest impact
- It is through this enabling platform that **transformation (T)** of the economy will occur, when standardisation, monitoring, accounting, optimisation and the business models that drive low carbon alternatives can be developed and diffused at scale across all sectors of the economy. “

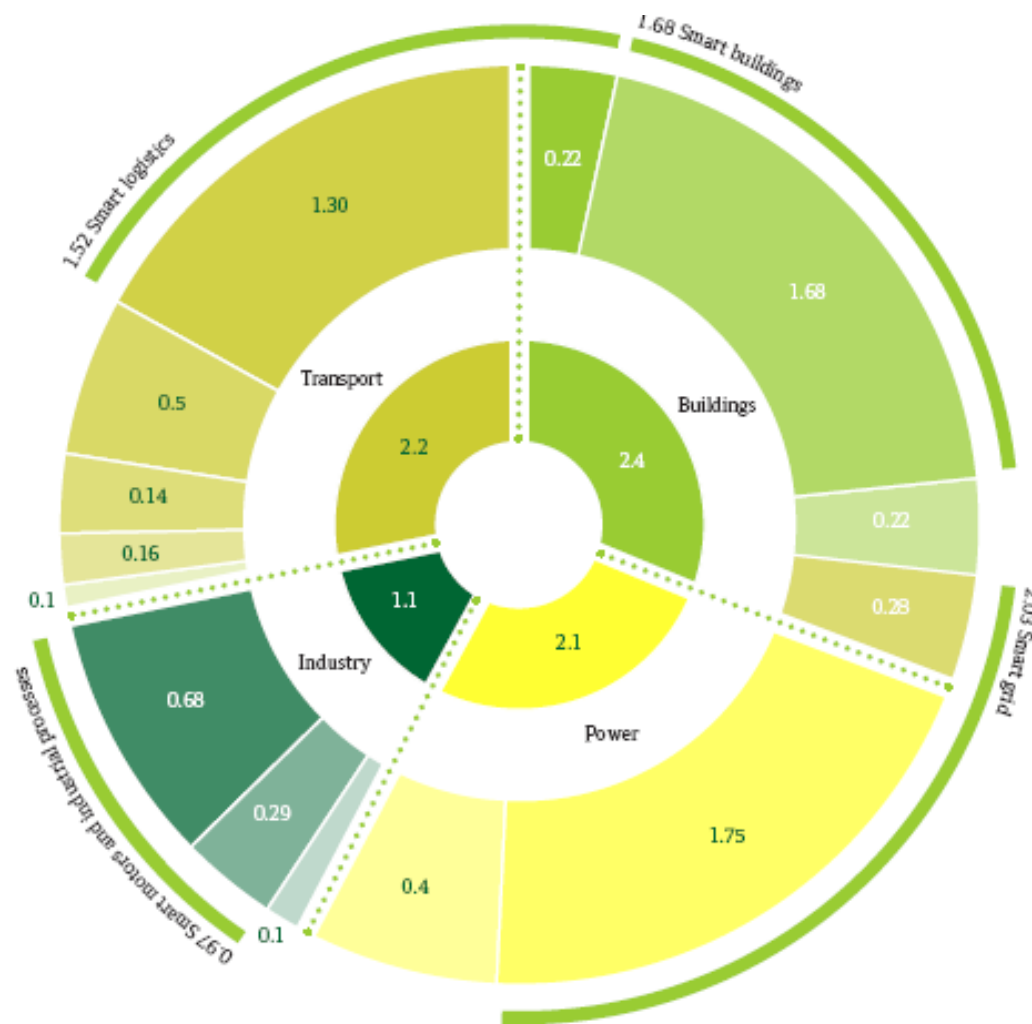
Sector emission savings from ICT – from 'SMART 2020'

GtCO₂e

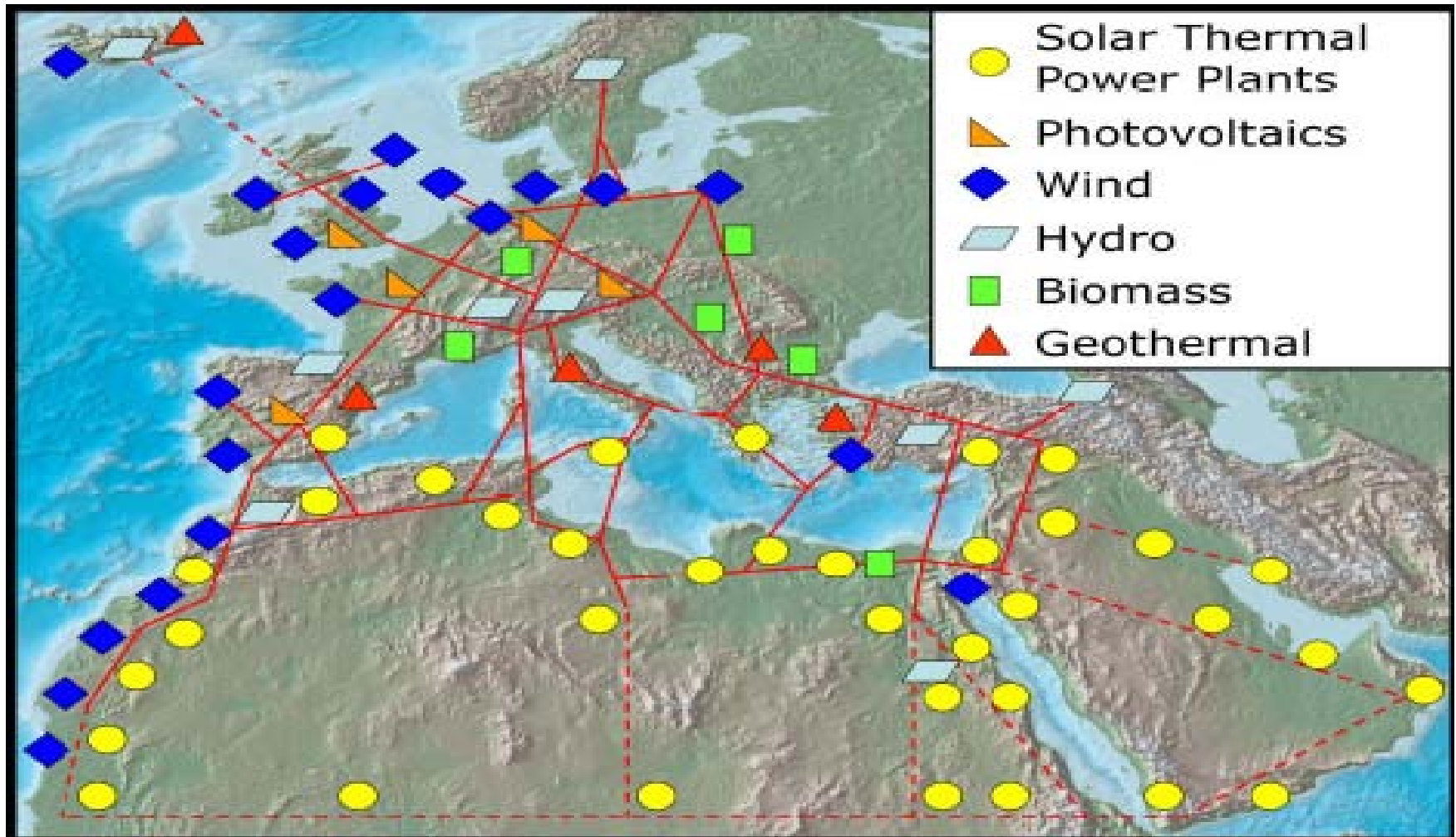
7.8 GtCO₂e of ICT-enabled abatement are possible out of the total BAU emissions in 2020 (51.9 GtCO₂e)

The SMART opportunities including dematerialisation were analysed in depth

- Industry**
 - Smart motors
 - Industrial process automation
 - Dematerialisation* (reduce production of DVDs, paper)
- Transport**
 - Smart logistics
 - Private transport optimisation
 - Dematerialisation (e-commerce, videoconferencing, teleworking)
 - Efficient vehicles (plug-ins and smart cars)
 - Traffic flow monitoring, planning and simulation
- Buildings**
 - Smart logistics†
 - Smart buildings
 - Dematerialisation (teleworking)
 - Smart grid‡
- Power**
 - Smart grid
 - Efficient generation of power; combined heat and power (CHP)



EU-Middle East–North Africa Renewables Super-grid = CLEAN ENERGY AND CLEAN WATER



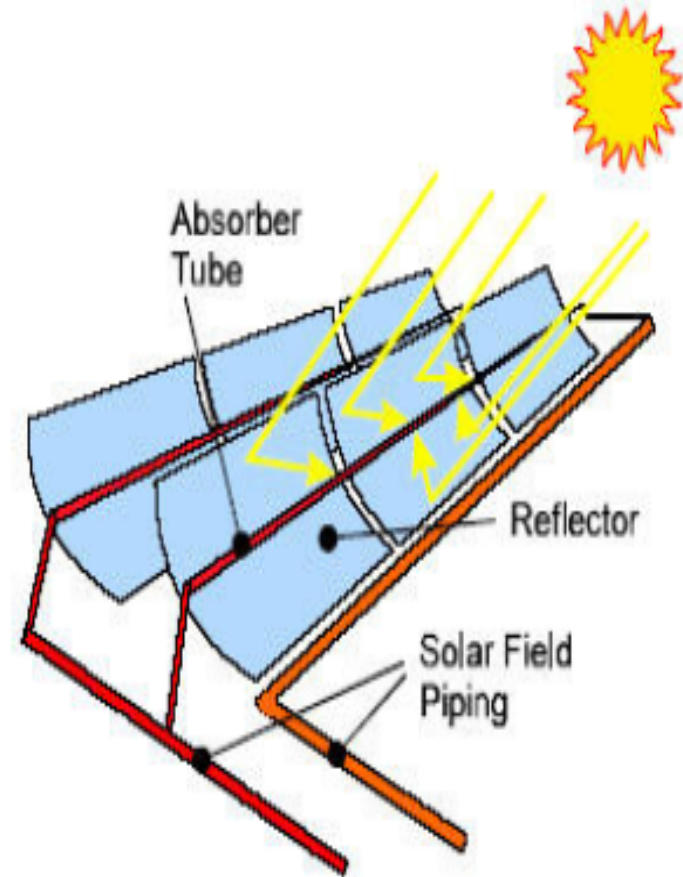
Sketch of possible infrastructure for a sustainable supply of power

http://www.desertec.org/downloads/summary_en.pdf

Concentrating solar thermal power technology (CSP)

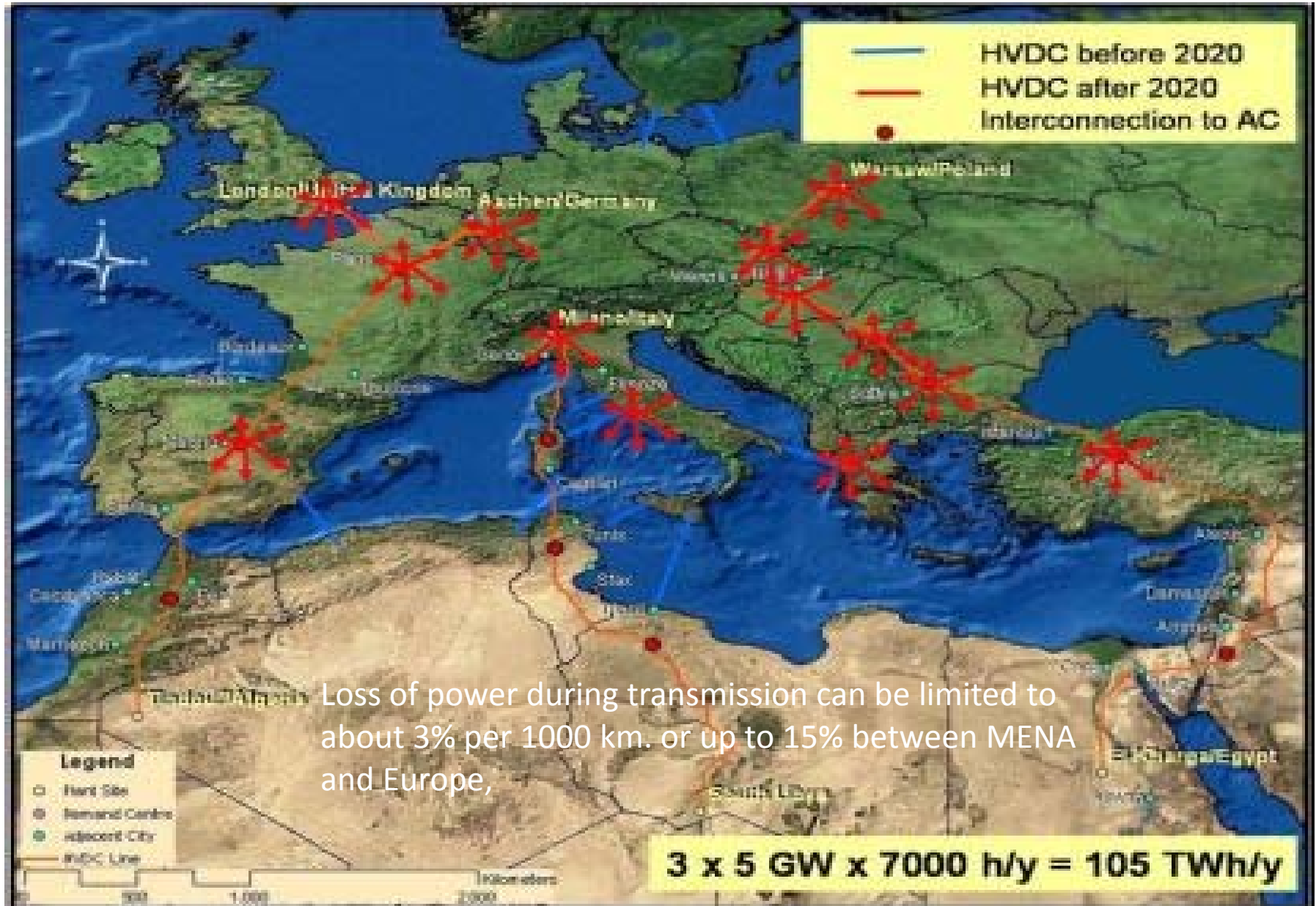


Parabolic trough collector field for the solar thermal power plant at Kramer Junction, California



Sketch of a **parabolic trough collector**
(A simplified alternative to a parabolic trough concentrator is the linear **Fresnel** mirror reflector.)

Low-loss High Voltage Direct Current transmission grid



Macro-policy elements of carbon reduction

Three essential elements, through a combination of national and city-level policy instruments + assistance programmes targeting companies, households, municipalities:

- **Carbon pricing**. Establish a price for carbon that captures the full social cost of the production and consumption of carbon (carbon trading; carbon taxes)
- **Technology policy**. Introduce policies to support the development of a range of low-carbon and high-efficiency technologies on an urgent timescale
- **Behavioural change**. Remove barriers to behavioural change, in particular encouraging the uptake of energy efficiency opportunities. **Does not require self-sacrifice and austerity.**

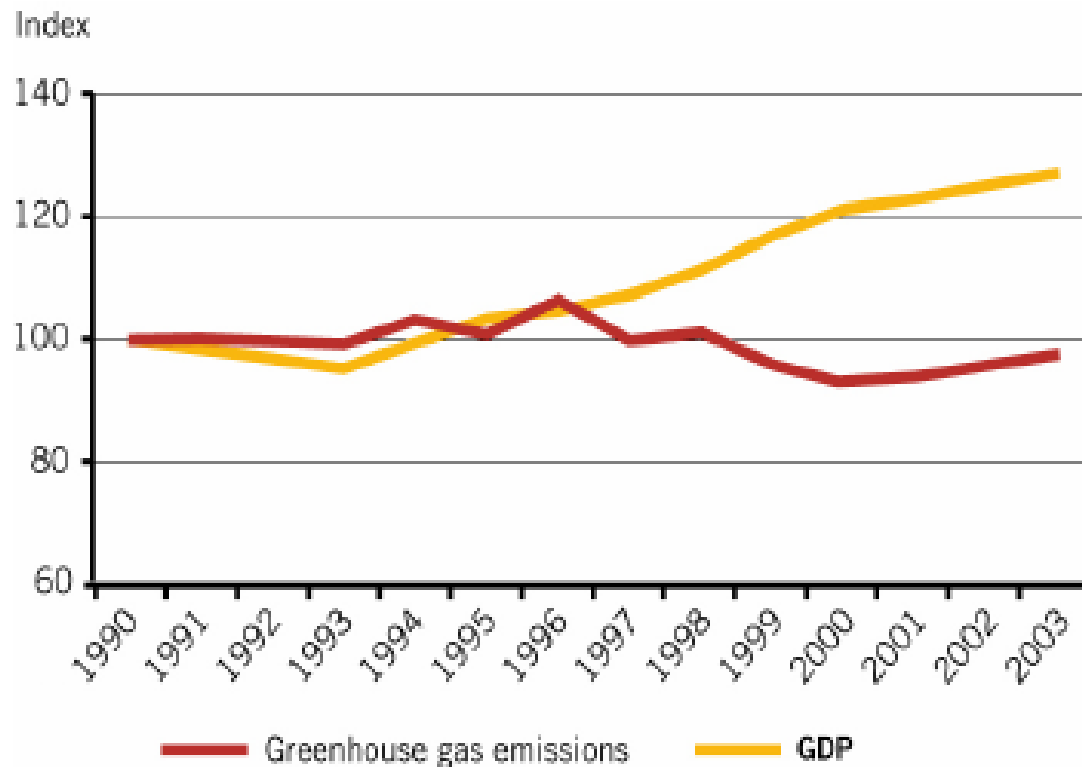
In all sectors except aviation the technologies to deliver are available or on the way to commercialisation. **The problem is existing taxation and regulation policies do not ensure that carbon emissions and wasted resources are taken into account in setting the price of most products and services = insufficient financial incentives for businesses and individuals to take the kinds of action necessary on necessary scale**

So, what does work ...

- **Laws and Regulations** to ban/restrict unsustainable behaviour
- **Polluter Pays Levies and Charges** – *if* revenues are recycled into low carbon solutions (infrastructure, technologies, products)
- **Financial Incentives** – grants, discounts, rewards for low carbon choices and behaviours – including procurement
- **Focused Advice and Assistance programmes** - convenient to access for user, and navigate a muddled market-place
- **Information on problems, causes and solutions** (help individuals, families companies in short-term)
- **Exemplar Best Practice** – ‘seeing is believing’
- **Partnerships** across public, private, domestic and voluntary sectors
- **Respected Champions** – local, professional, celebrity, political, business
- **Coordinated and demonstrable international action** – between companies, communities and countries

Decoupling GDP-GHG emissions

SWEDEN



Steady increase in GDP of about 25% (1990-2003)

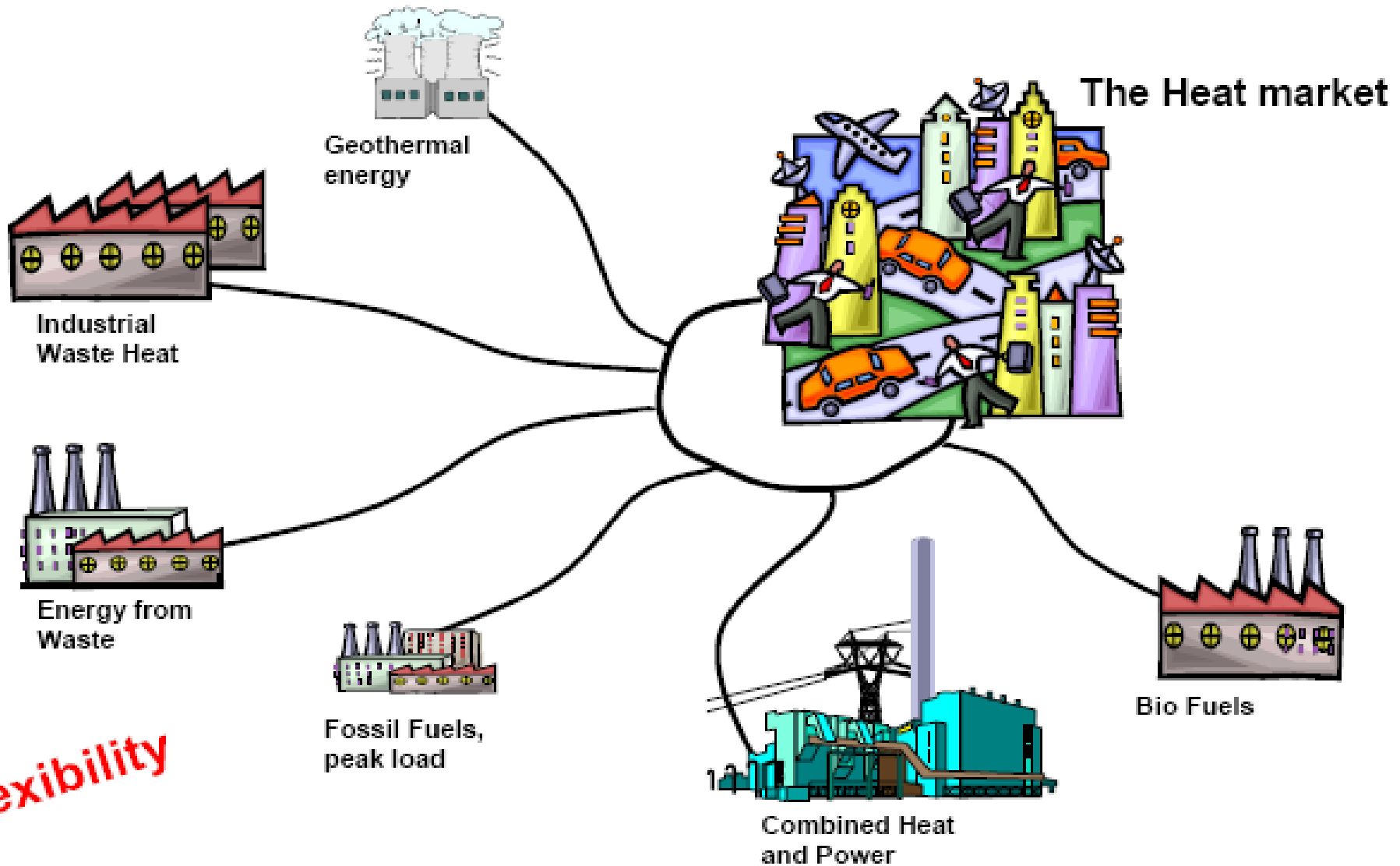
Industrial production increased by more than 50%

Average purchasing power grew by about 13%

GHG emissions decreased by 3% (1990-2003)

The foundation of an evolving, low-carbon, dematerialised, sustainable economic model

District Heating; grid and sources

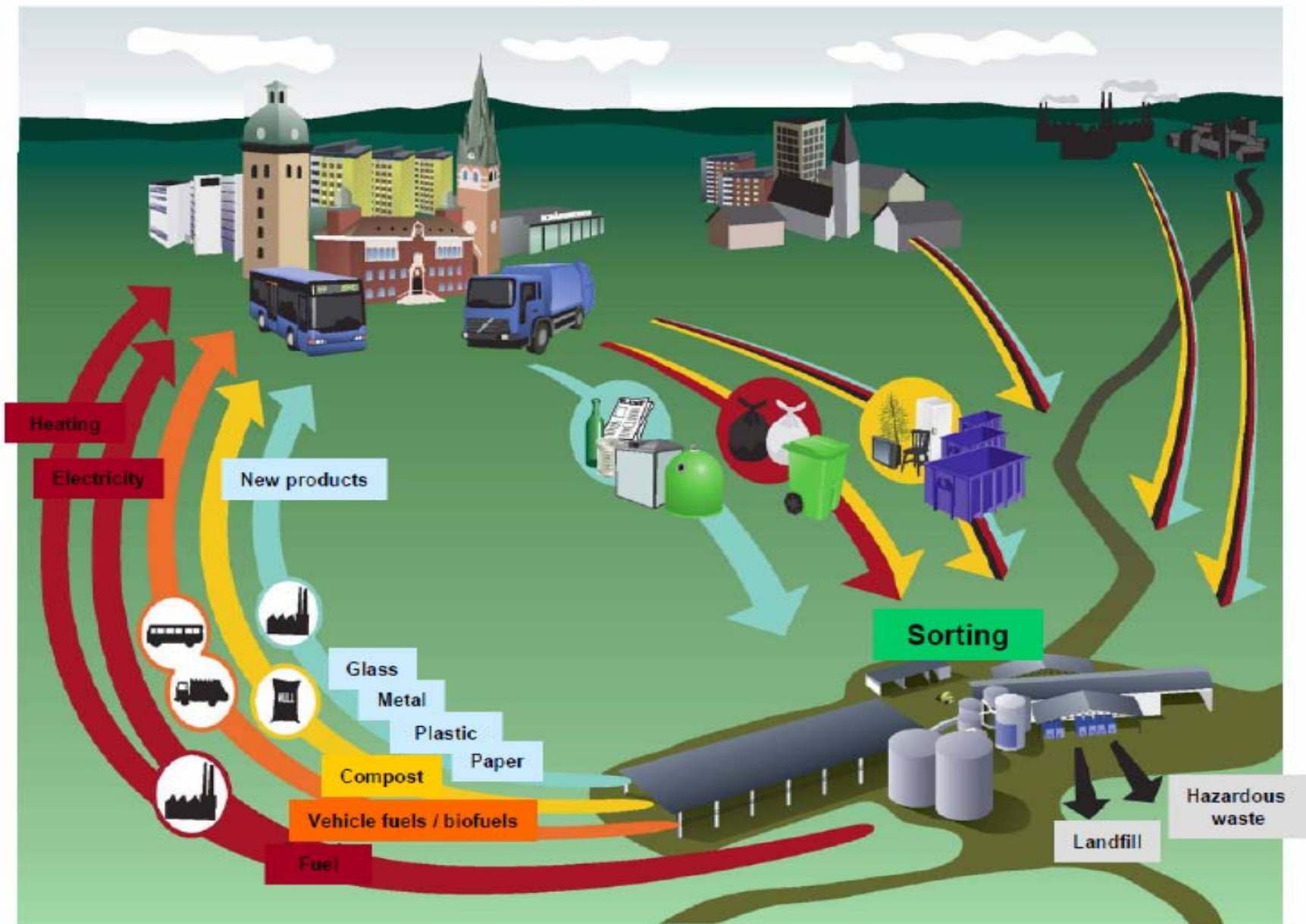


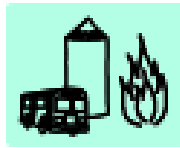
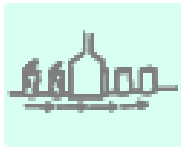
Flexibility

Steps to reduce oil/gas dependency

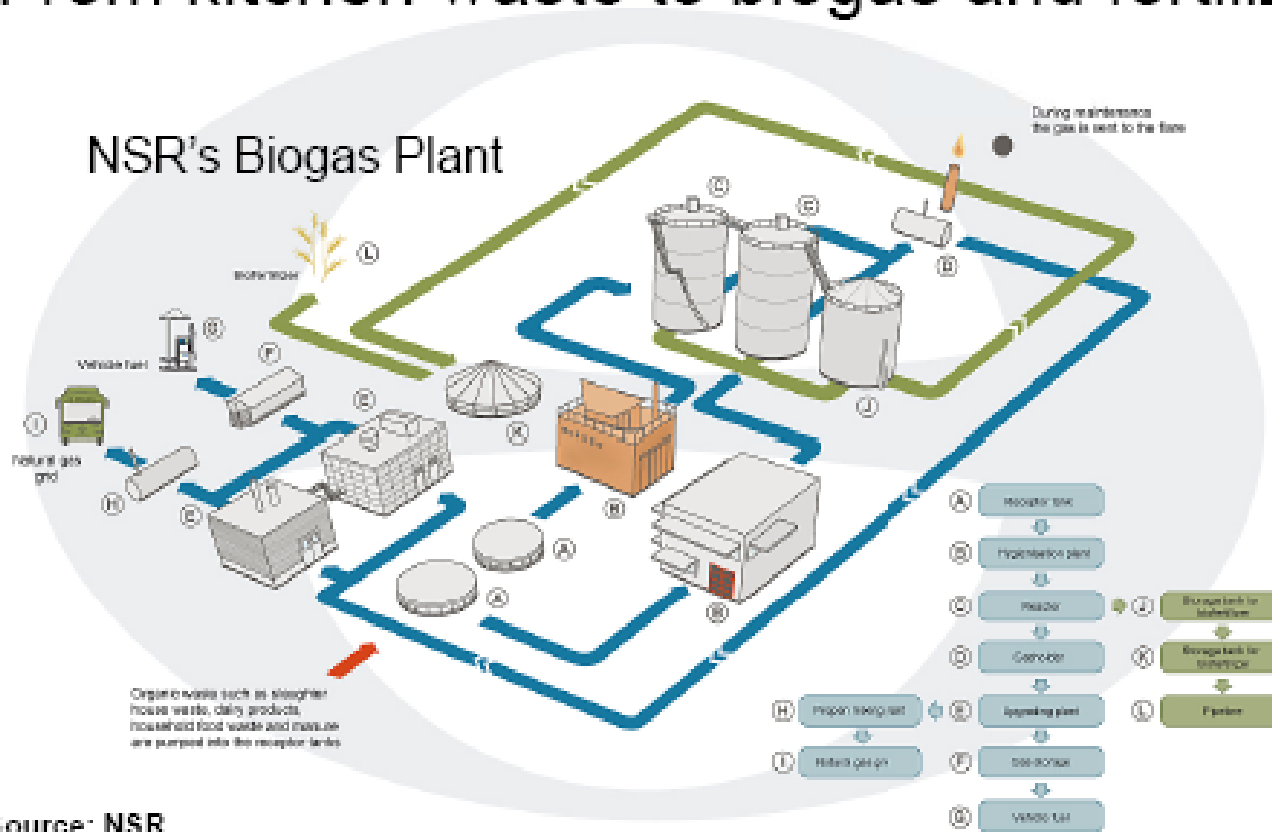
- **Recover wasted energy from powerplants and industry (natural gas too valuable for heating)**
- **Use energy from waste (solid and water)**
- **Combined Heat/Cooling and Power (CHCP)**
- **Use 90% of energy content (typical = 35%)**
- **Sort out organic (food waste)**
- **Substitute oil in transport via biogas as vehicle fuel, public transport, hybrids/clean vehicles**
- **Produce fertilizer/soil (80% of energy in crops)**
- **Continuous Improvements**

Treatment and origin of waste





From kitchen waste to biogas and fertilizer

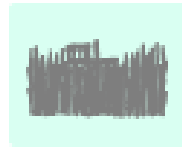
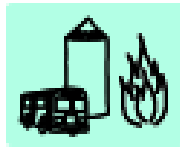
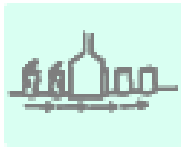


Source: NSR



Biogas production from organic waste





City integrated vehicle biogas system

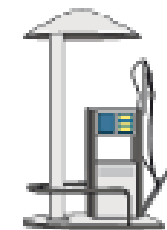
Helsingborg Sewage Treatment Plant

Digester Plant,
Upgrading plant
for vehicle fuel

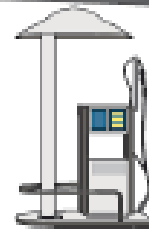


NSR[®] AB
Digester Plant,
Upgrading plants
for vehicle fuel,

Gas storage



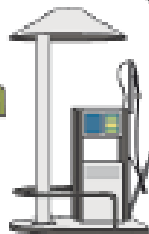
Filling station 2



Filling station 3



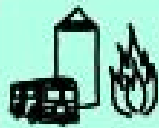
Filling station for busses



Filling station 1

Local gas grid

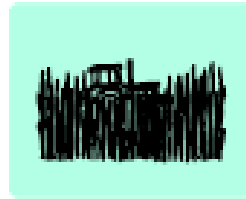
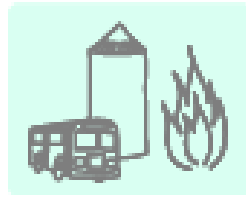
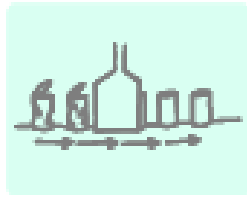
Source: NSR



Biogas filling of city buses



Source: NSR



Nutrient recycling

Biogas sludge transformed to bio fertilizer

- Certification of the product
- Efficient distribution to farmland



Biofertilizer distribution



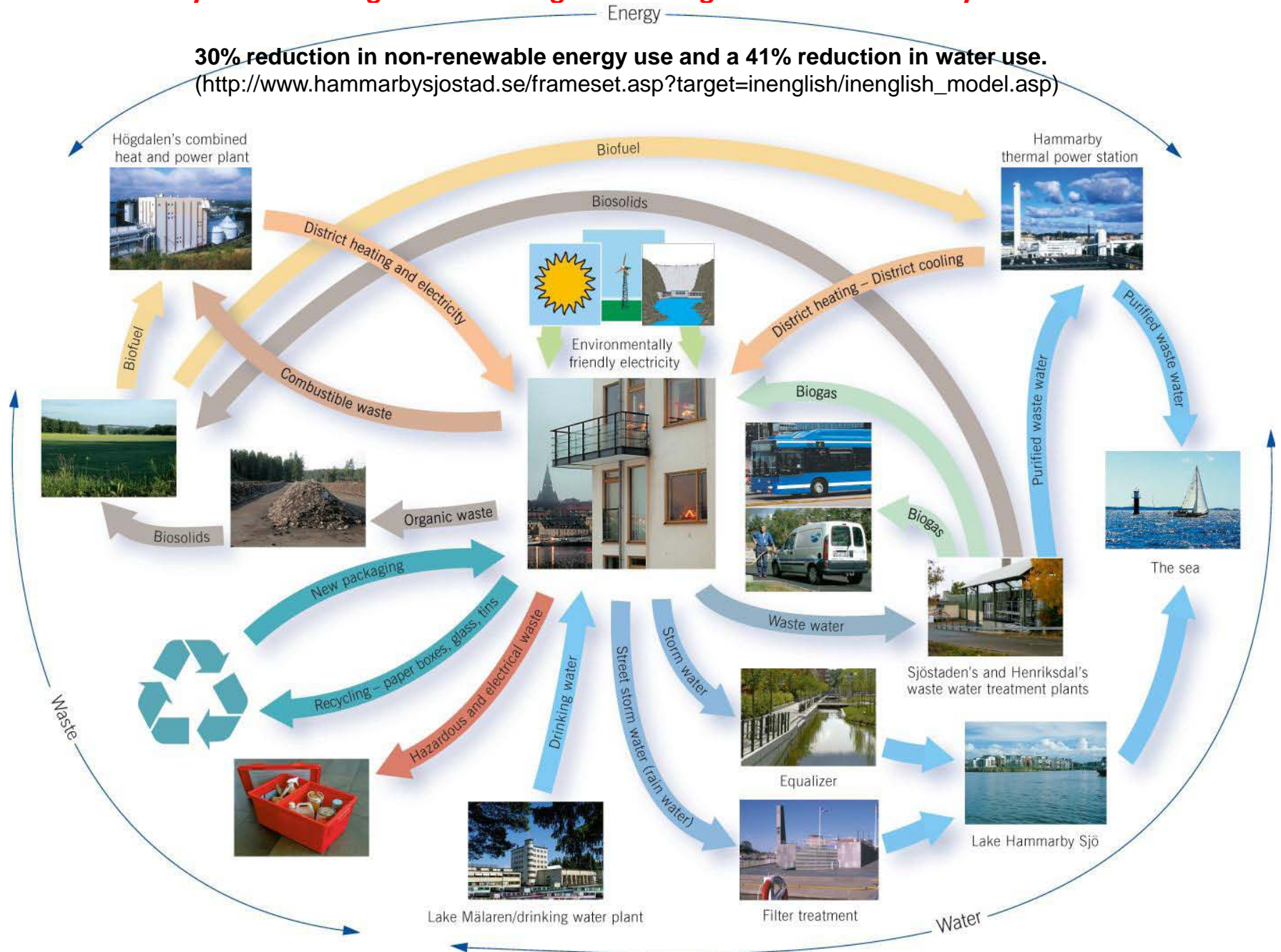
Source: NSR

Stockholm – Hammarby Sjöstaad

A New Economy Model - Integrated Planning and Management based on a cyclical urban 'metabolism'

30% reduction in non-renewable energy use and a 41% reduction in water use.

(http://www.hammarbysjostad.se/frameset.asp?target=inenglish/inenglish_model.asp)



Paradigm shifts – hybrids, hydrogen fuel cell or electric?



Nissan Pivo electric prototype

‘E-mobility Germany’
Smartcar/Daimler
RWE electricity charging



**Link renewables into
a Smart Grid
*and store in electric
vehicles/batteries***

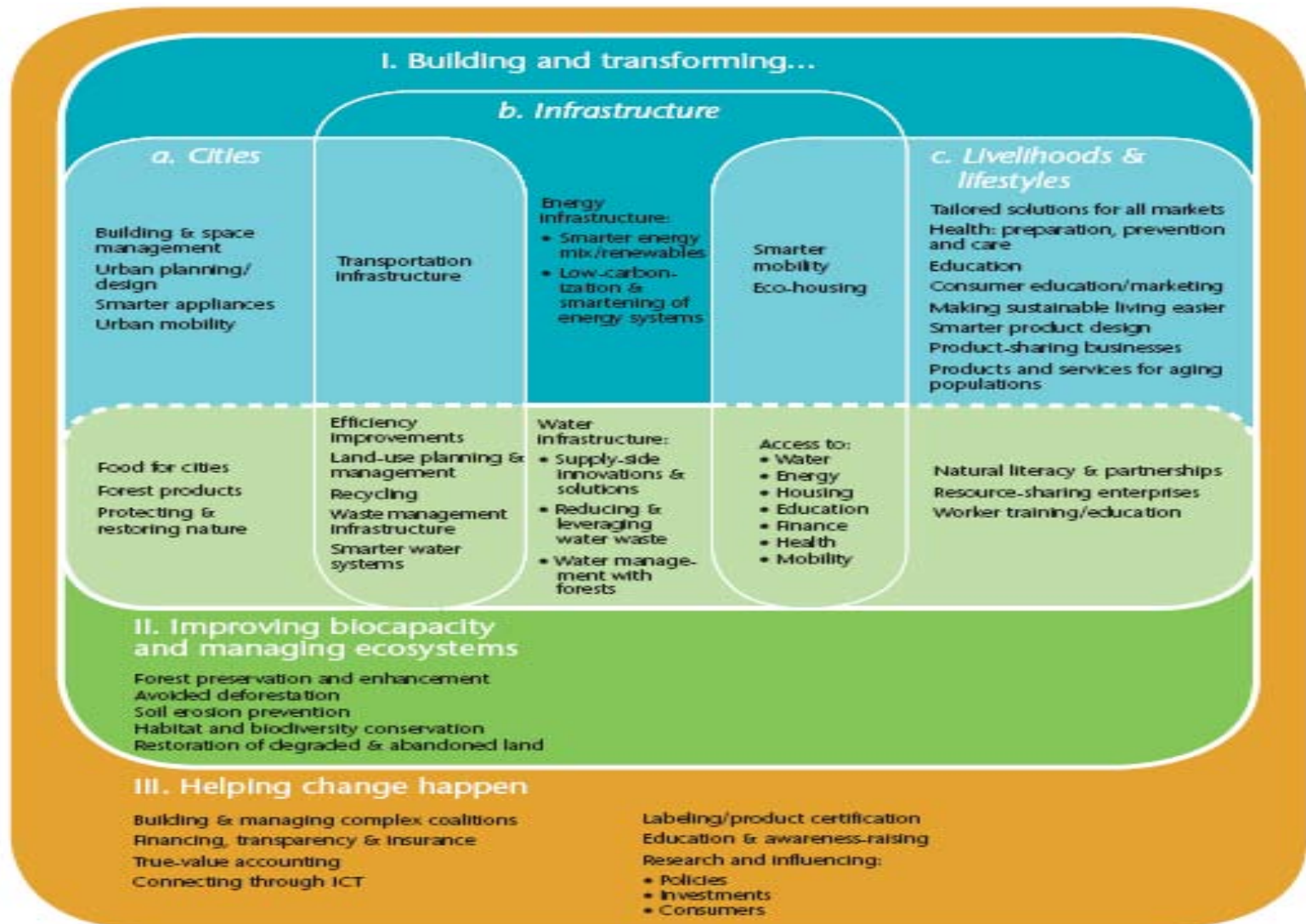


**North Port Quay -
Perth Carbon-free
based on renewables,
Smart Grid and
electric vehicles with
green buildings.
Smart Centre...**



WBCSD 2050 VISION

These opportunities provide a strategic thinking and collaboration space for business



WBCSD GOALS

- Addressing the development needs of billions of people, enabling education and economic empowerment, particularly of women, and developing radically more eco-efficient solutions, lifestyles and behavior
- Incorporating the cost of externalities, starting with carbon, ecosystem services and water
- Doubling of agricultural output without increasing the amount of land or water used
- Halting deforestation and increasing yields from planted forests
- Halving carbon emissions worldwide (based on 2005 levels) by 2050, with greenhouse gas emissions peaking around 2020 through a shift to low-carbon energy systems and highly improved demand-side energy efficiency
- Providing universal access to low-carbon mobility
- Delivering a four-to-tenfold improvement in the use of resources and materials.

THE UK CLIMATE CHANGE COMMITTEE

The Renewable Energy Review (May 2011) B

- **Electricity generation**

- Promising options for delivering decarbonisation by 2030 at reasonable cost includes renewables, nuclear, carbon capture and storage (CCS).
- Firm commitments on offshore wind and marine generation through the 2020s make now and implement through the new electricity market.
- If renewable energy targets for 2020 can be met in other ways, a moderation of offshore wind ambition for 2020 could reduce costs of decarbonisation.

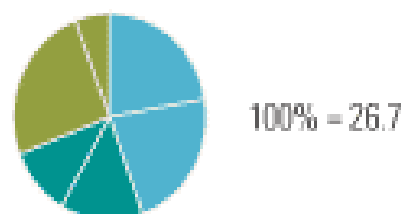
- **Heat**

- Further funding to support renewable heat in the period 2015-20 and 2020s.
- Approaches to renewable heat and energy efficiency (i.e. the Renewable Heat Incentive and the Green Deal) should be integrated.
- Accreditation of installers crucial to avoid supply chain bottlenecks and improve consumer confidence.

- **Transport**

- Cautious approach to biofuels until/unless sustainability concerns resolved.

Abatement potential for greenhouse gases by sector, GtCO₂e¹ per year by 2030 (costing up to €40 per ton)



Possible abatement measures (examples)

Power, manufacturing



- Renewables (wind, solar, biomass)
- Nuclear
- Carbon capture and storage
- Energy efficiency (eg. cogeneration, process shift)
- Fuel switching (eg. biofuels)
- Carbon capture and storage in industrial process

Buildings, transportation



- Improved building insulation, heating/cooling efficiency
- Energy efficiency in lighting, appliances
- Fuel-efficient vehicles
- Biofuels

Forestry, agriculture



- Deforestation avoided
- Afforestation/reforestation
- Capture of methane from landfills
- New agricultural methods without tillage²

¹ GtCO₂e = gigaton of carbon dioxide equivalent.

² Reduces CO₂ emissions from soil.

Imperatives to successfully change **carbon-materials heavy** behaviour

1. **Long-term strategy with best science targets** and policy drivers to transform markets to value zero/low carbon
2. **Enabling policy (tax, spend, assistance) framework of 'carrots and sticks'** for companies and citizens
3. **Cheaper, more convenient and integrated low carbon-waste solutions**
4. **Exemplar zero-low carbon/waste developments** and projects
5. **Comprehensive information, advice and audit** programmes for households and companies
6. **Verifiable, coordinated and effective** international action
7. **Partnerships between sectors** – public, private, domestic, voluntary
8. **Integrated changes across economic sectors** – especially financial, energy, transport, waste, buildings
9. **Leadership** – political, professional, personal
10. **Prioritise win-win-win and no-regrets** policies and programmes