Smart Grids: Fact or Fiction!

Duncan Botting
Managing Director GST
Executive Chair Scottish European Green Energy Centre

But first an EU definition

- *"A SmartGrid is an electricity network that can intelligently integrate the actions of all users connected to it – generators, consumers and those that do both – in order to efficiently deliver sustainable, economic and secure electricity supplies."*

And.....

Smart Grid definition..... continued!

- *A SmartGrid employs innovative products and services together with intelligent monitoring, control, communication, and self-healing technologies to:*
  - *better facilitate the connection and operation of generators of all sizes and technologies;*
  - *allow consumers to play a part in optimizing the operation of the system;*
  - *provide consumers with greater information and choice of supply;*
  - *significantly reduce the environmental impact of the whole electricity supply system;*
  - *deliver enhanced levels of reliability and security of supply.*
- *SmartGrids deployment must include not only technology, market and commercial considerations, environmental impact, regulatory framework, standardization usage, ICT (Information & Communication Technology) and migration strategy but also societal requirements and governmental edicts."*

COMMISSIONED BY THE I.E.T. BIG PICTURE (2)

ARTWORK BY: THE CLARITY PARTNERSHIP

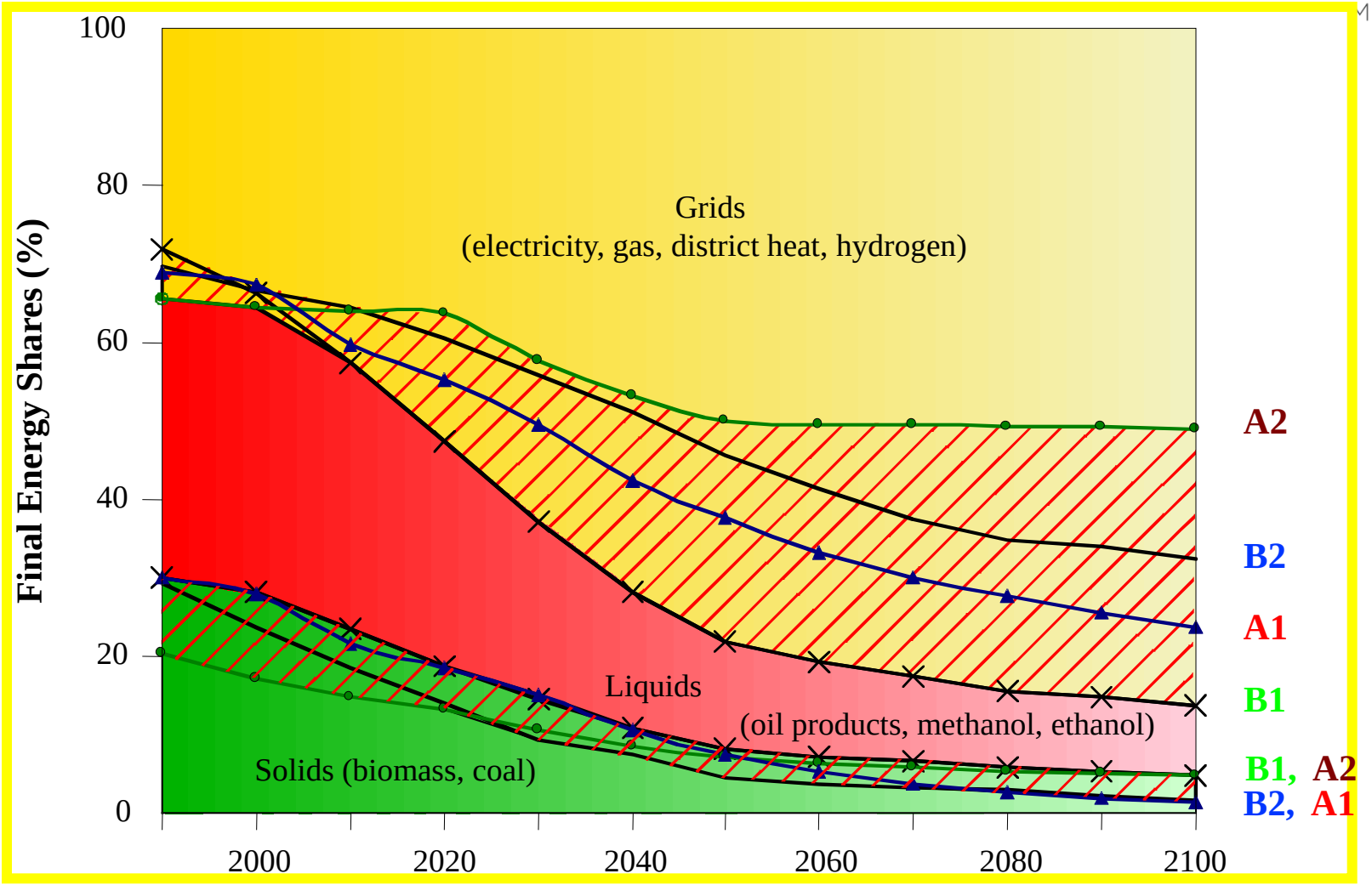

SMART GRIDS: A COHERENT VISION FOR 2025 AND BEYOND
SAVE THE PLANET
SOLD
SOLD
GSHP
METER
ELECTRICITY
CO_2
GAS
SUPPLY
DEMAND
99.99997%
CONTROL DESK
THIS IS FUN
THANK GOODNESS WE'VE GOT THE SKILLS..
ENERGY MINISTER
ENERGY MINISTER
CO_2
SPONSORED BY THE I.E.T. BIG PICTURE (3)
A JOINT INITIATIVE BY THE CLIMATE PARTNERSHIP


SMART GRIDS:
A VISION FOR 2050
SAVE THE PLANET
HYMN BOOK
BIOMASS
CHP
G.S.H.P.
ONE-STOP SHOP
ELECTRICITY
COOLING
HEAT
CARBON
KWH
CO_2
SUPPLY
DEMAND
99.999999999% AT A PRICE
I MADE IT!!
SAVE THE PLANET
BIOMASS
CO_2
SPONSORED BY THE I.E.T.
BIG PICTURE (4)
ARTWORK BY: THE CLARITY PARTNERSHIP

Why Grids at all?

- They connect demand to generation in the most efficient, robust and cost effective manner
- Why worry we already have them?
  - Clearly they were designed for top-down distribution and not bottom-up!
  - Changing requirements demand different approaches
  - Ageing infrastructure provides an opportunity to replace and re-shape the Grids of 2050 and beyond – **now!**
- Without Grids efficiency of scale, resource and security cannot be captured – even in a distributed environment!
- Grids of the future will be the integration medium for all future demand side and generation allowing seamless operation, balancing and trading.
- Flexibility must be the watch-word for the future Grids!

The Future – Grids 2100

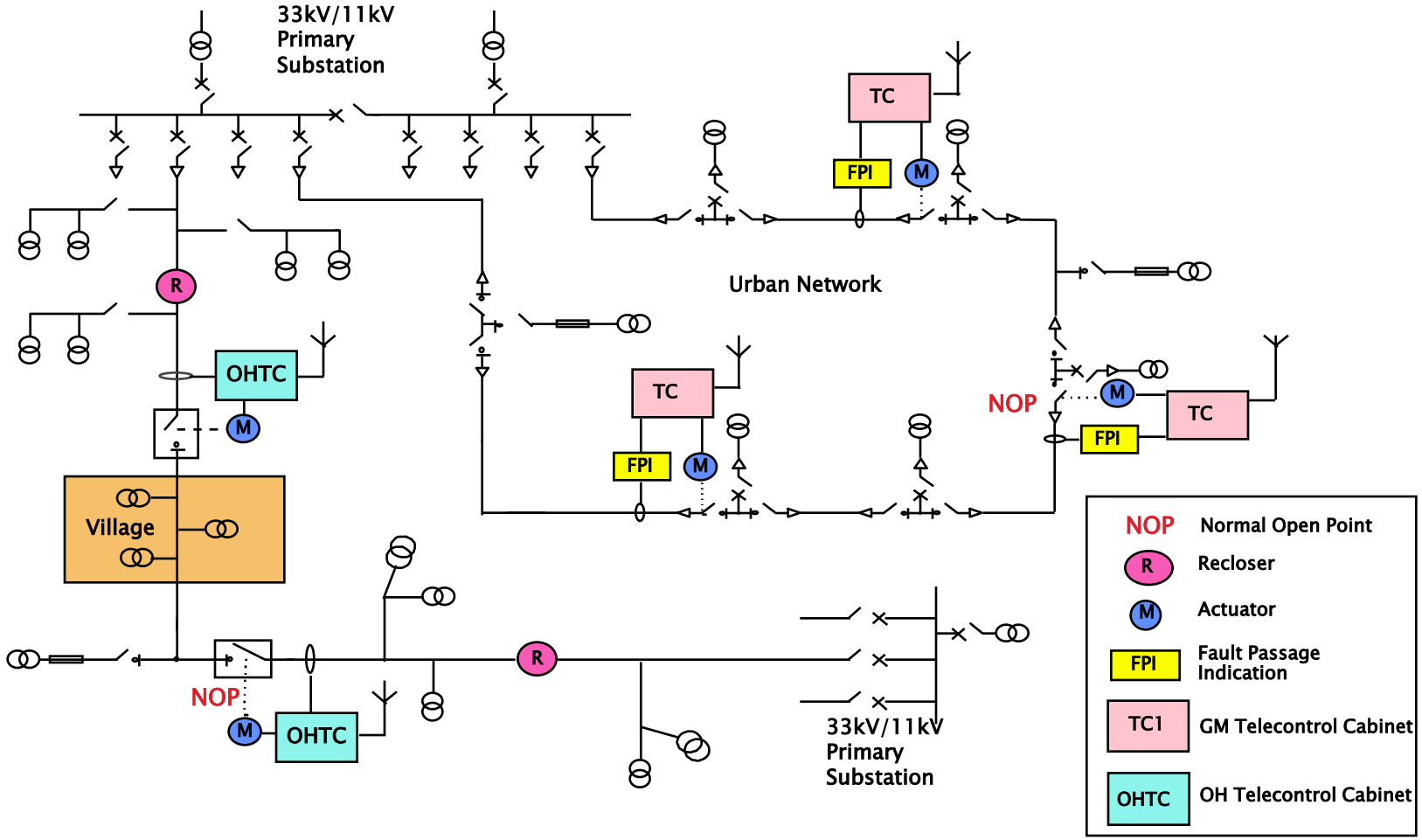


Source: IIASA & IPCC SRES Scenarios

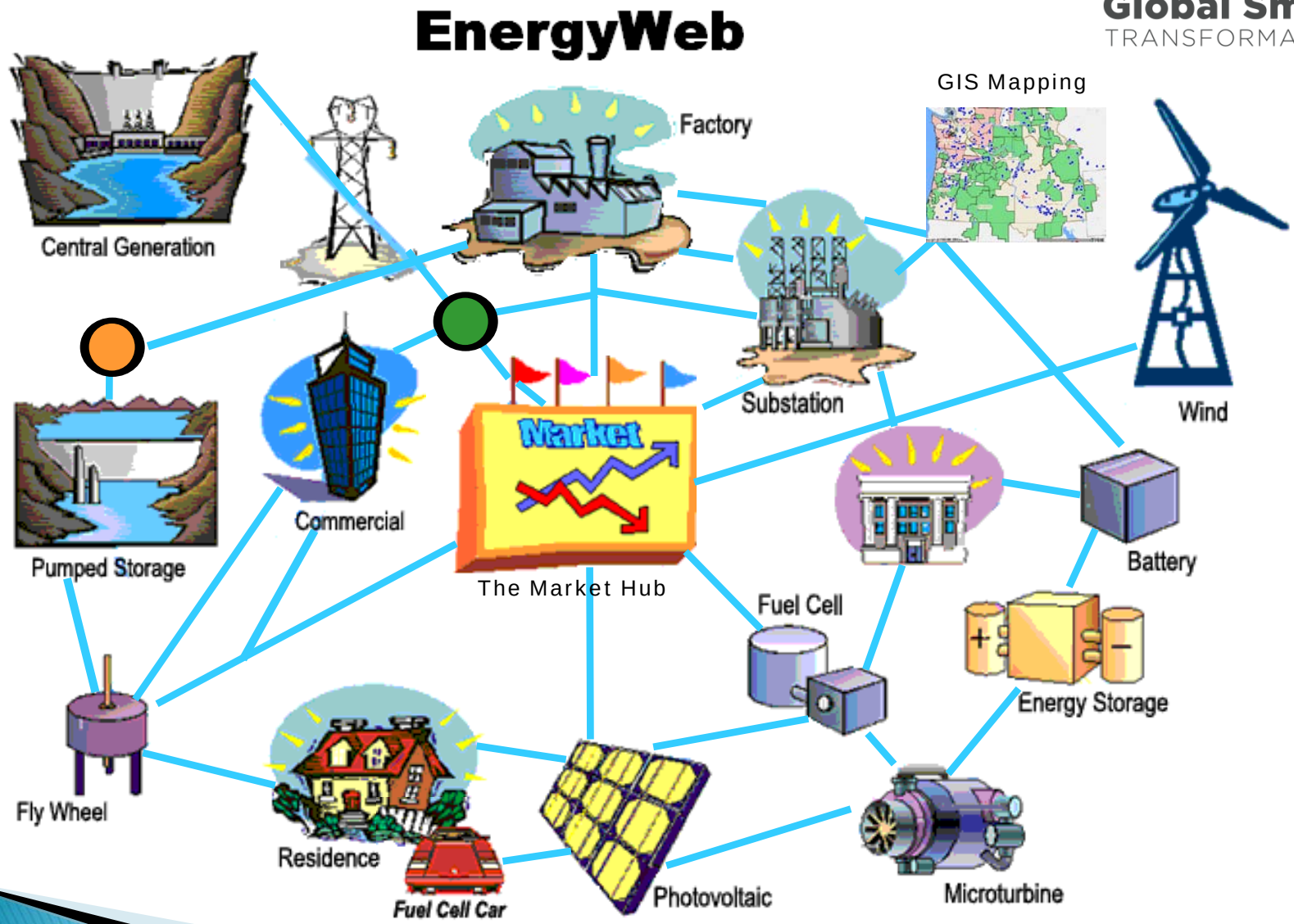
From traditional to renewable

Global Smart TRANSFORMATION

Is this Technical Architecture?



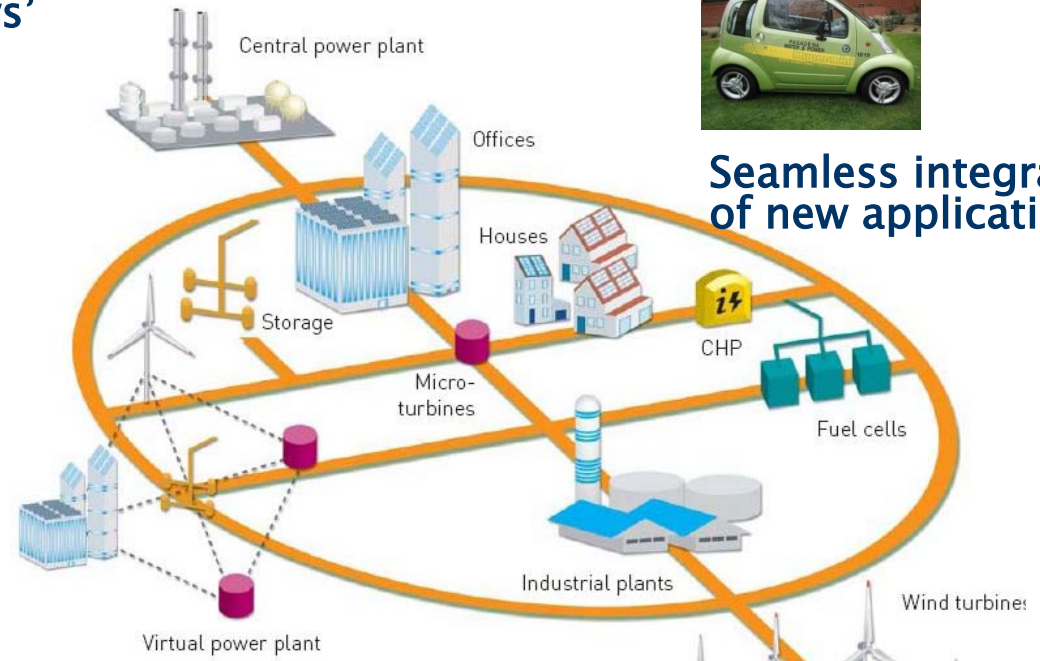
….. or is this?



Source: BPA

SmartGrids Vision

Multi-directional 'flows'



Seamless integration of new applications

End user real time Information & participation

Central & dispersed intelligence

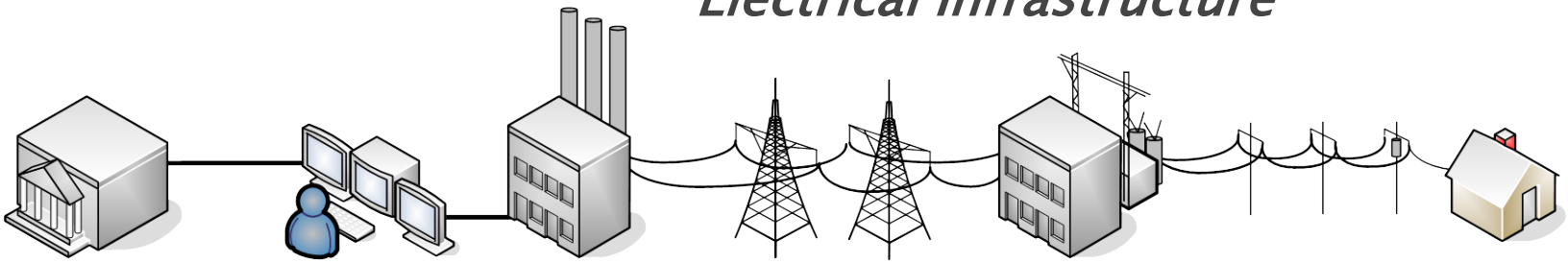
Smart materials and power electronics

Central & dispersed sources

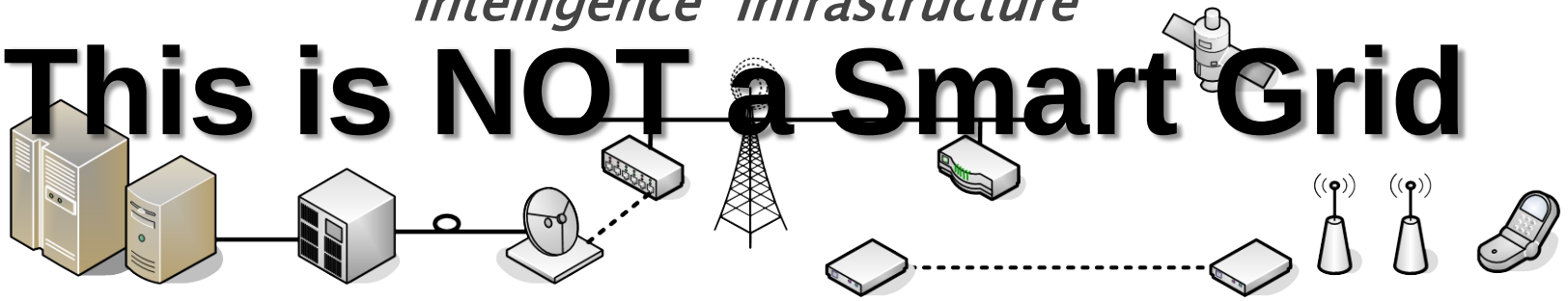
The power and information networks

Global Smart TRANSFORMATION

Electrical Infrastructure

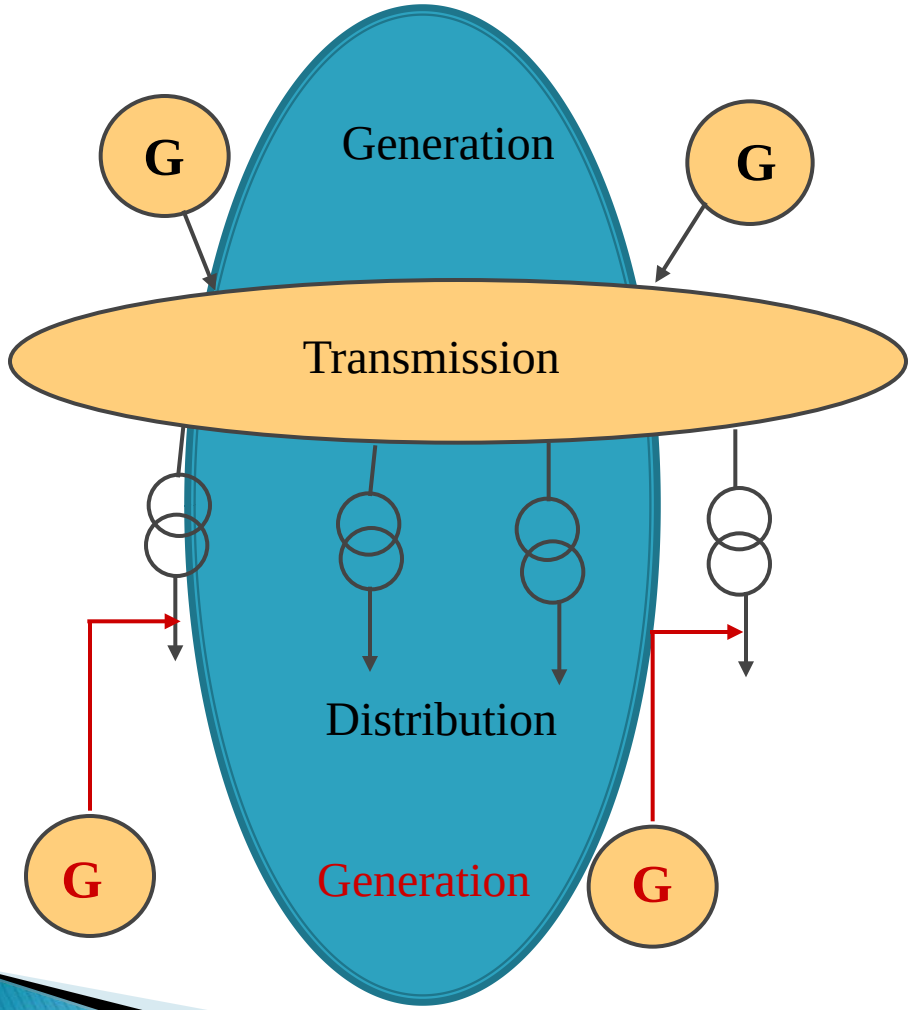


"Intelligence" Infrastructure



This is NOT a Smart Grid

New Generation Paradigm



Supply

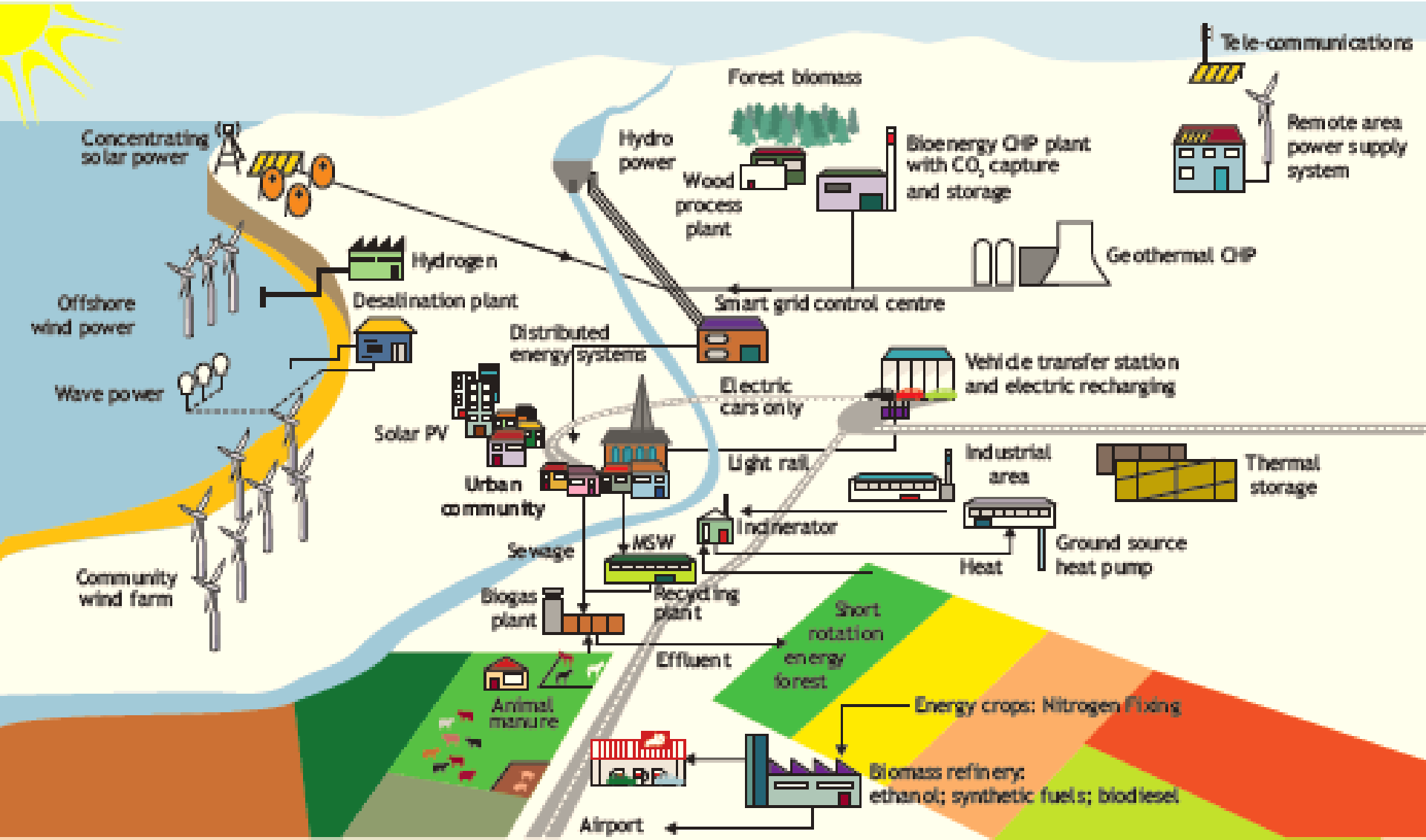
Traditional one-way supply system

Bi-directional supply system

Demand Generation

Smart.....

Global Smart TRANSFORMATION



Smart Infrastructure

Opportunities over next few years…

- FP7 (R&D) €23bn on energy
- European Industrial Initiatives
  - Wind €6bn – Solar €16bn
  - Grid €2bn – Bio energy €9bn
  - CCS €13bn

  R&D, demonstration at commercial scale
- EEPR €4bn
- Emission Trading Scheme New Entrants Reserve
  - €5bn – €10bn
  - CCS and renewables demonstration projects

Challenges for 2020 and beyond

European power system

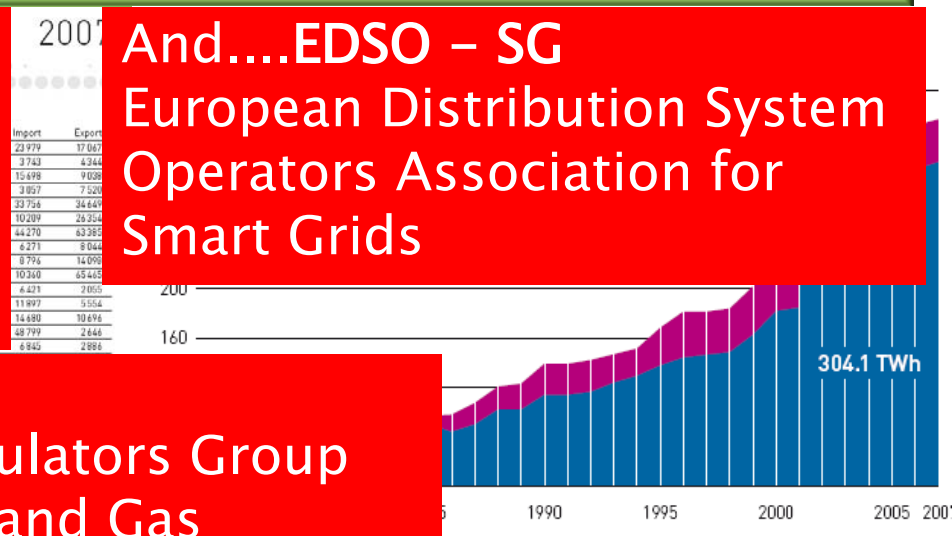
- 430 million people served
- 2500 TWh us
- 560 GW inst
- 230 000 km

- Approx. 5 000 000 km MV+LV network
- citizen
- ade systems

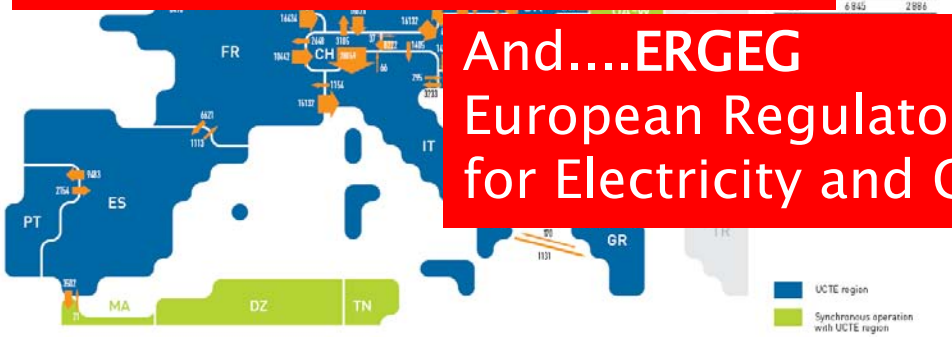
From FT WORLD 5:44pm **Downturn longest since Great Depression**

As of July 2009, the work of ATSOI, BALTSO, ETSO, NORDEL, UCTE and UKTSOA has been fully integrated into *ENTSO–E*.

And....**EDSO – SG**
European Distribution System Operators Association for Smart Grids



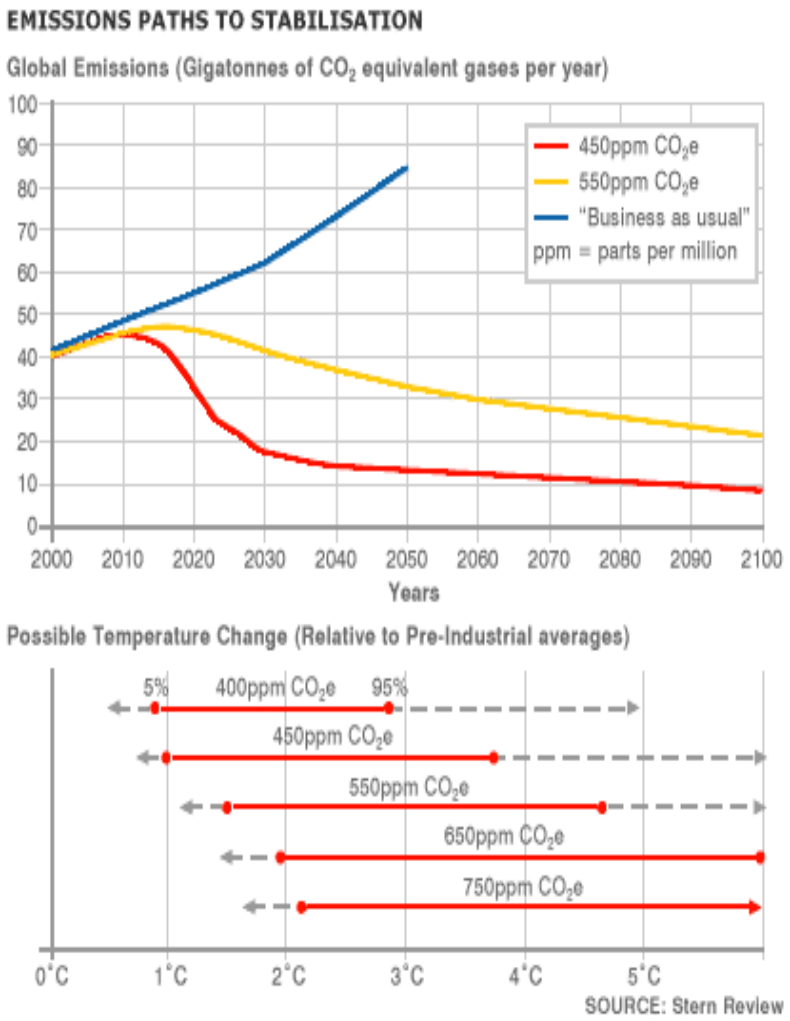
And....**ERGEG**
European Regulators Group for Electricity and Gas



UCTE

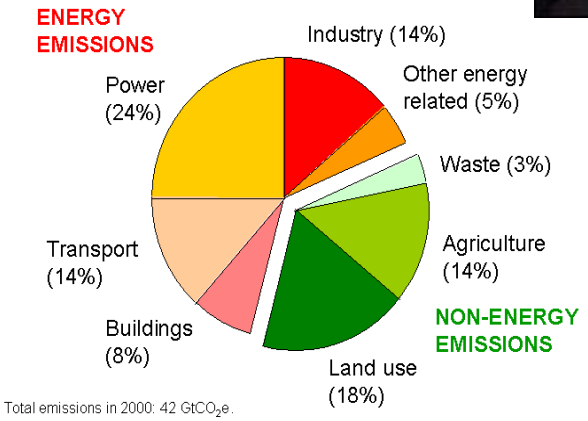
entsoe

Stern Report – A remarkable document



"We have the time and knowledge to act but only if we act internationally, strongly and urgently"

Sir Nicholas Stern



Source: Stern Report October 2006

Four ways to cut emissions:

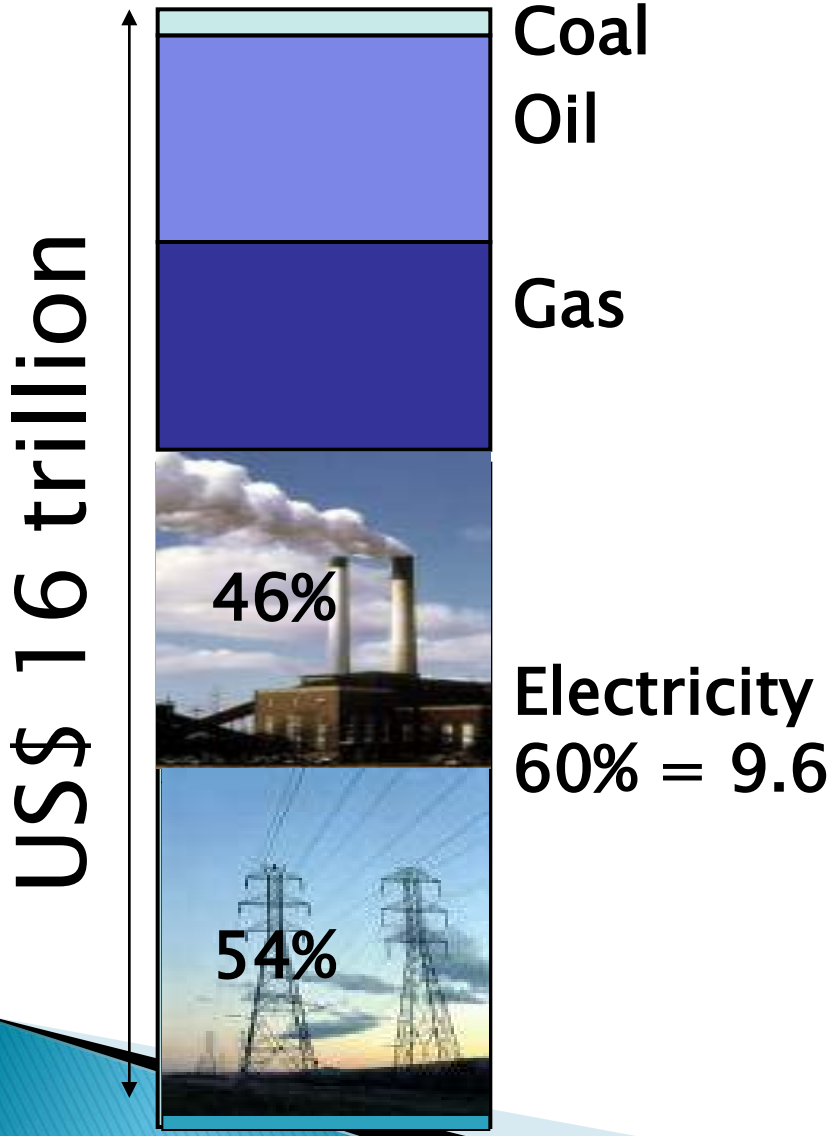
reducing demand;

improving efficiency;

using lower-carbon technologies;

tackling non-energy emissions.

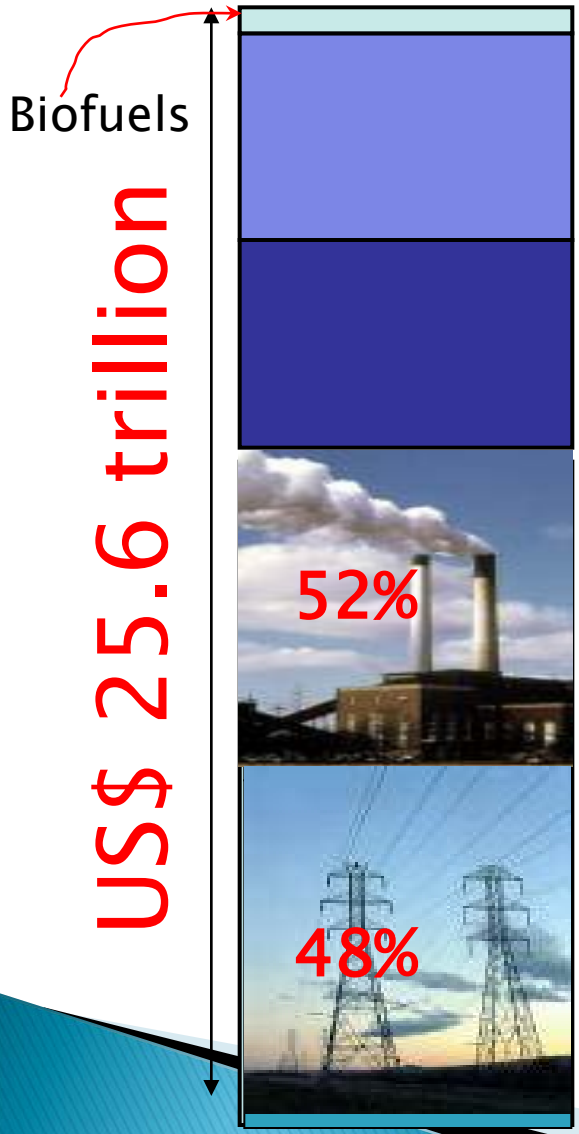
World energy investment 2001–2030



"If present trends continue, the world will need to invest *$16 trillion* over the next three decades to maintain and expand energy supply"

IEA 2004

World energy investment 2001–2030

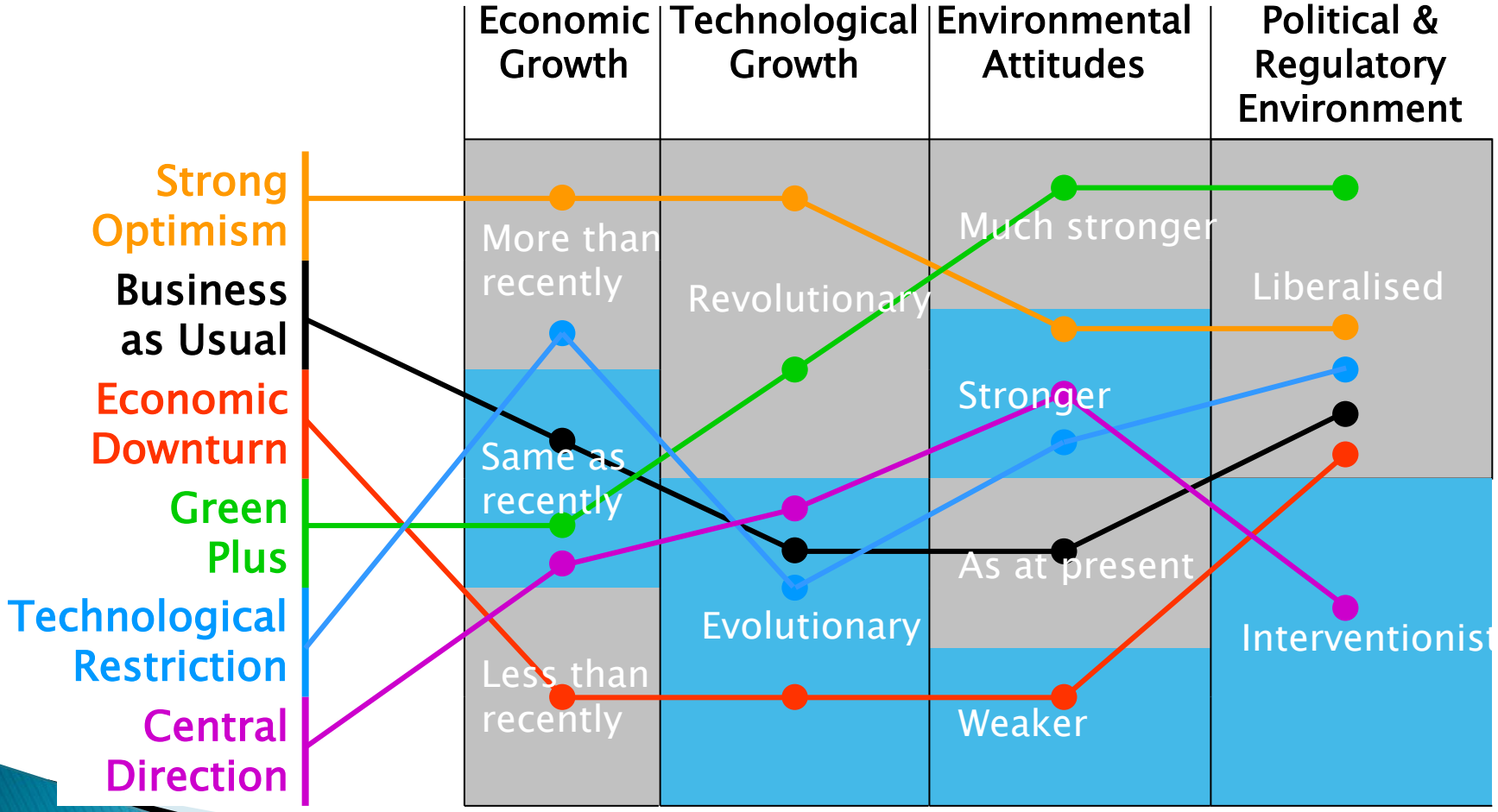


Electricity
53% = 12.3

"If present trends continue, the world will need to invest *$25.6 trillion* over the next three decades to maintain and expand energy supply"

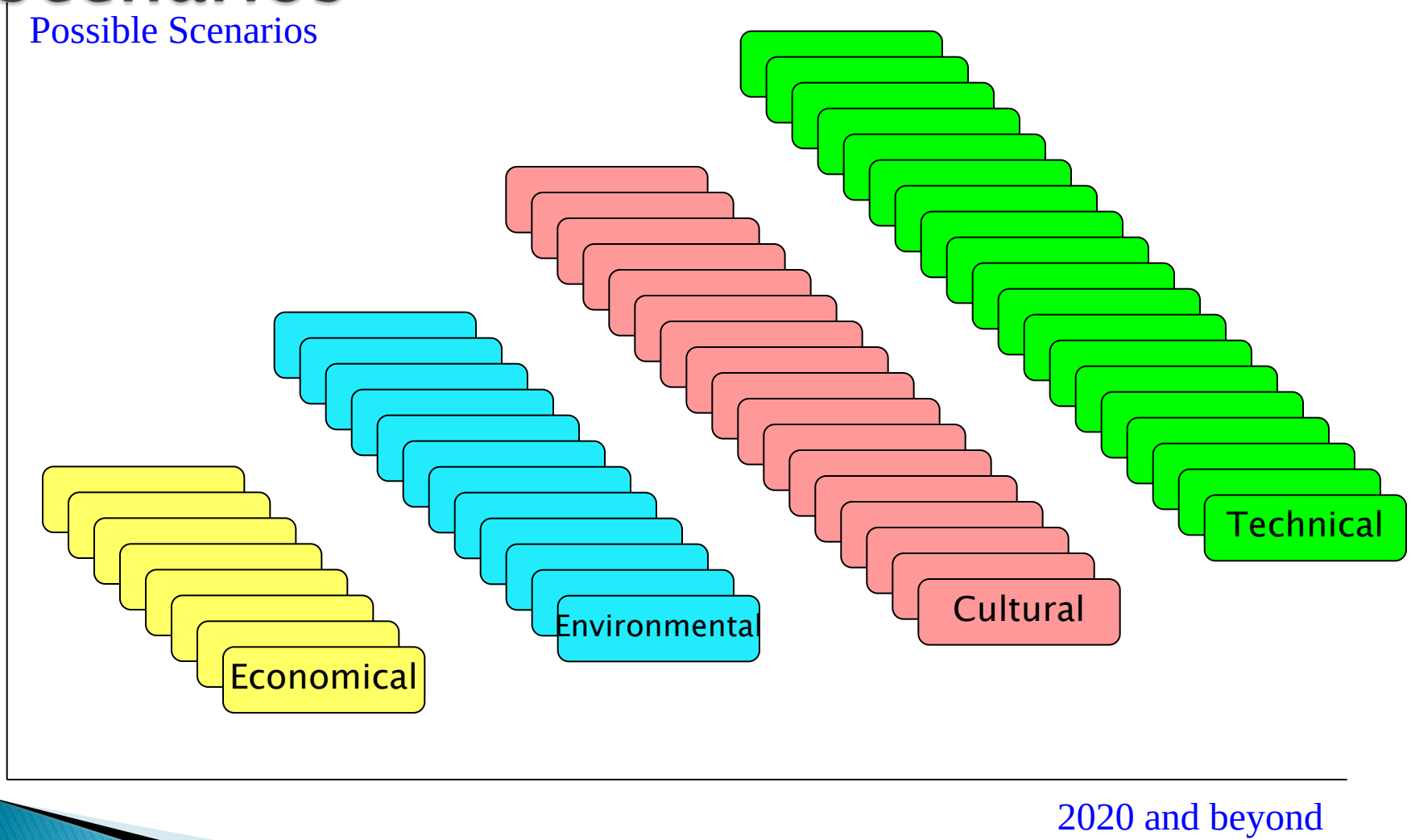
IEA 2009

Supergen Scenarios for 2050

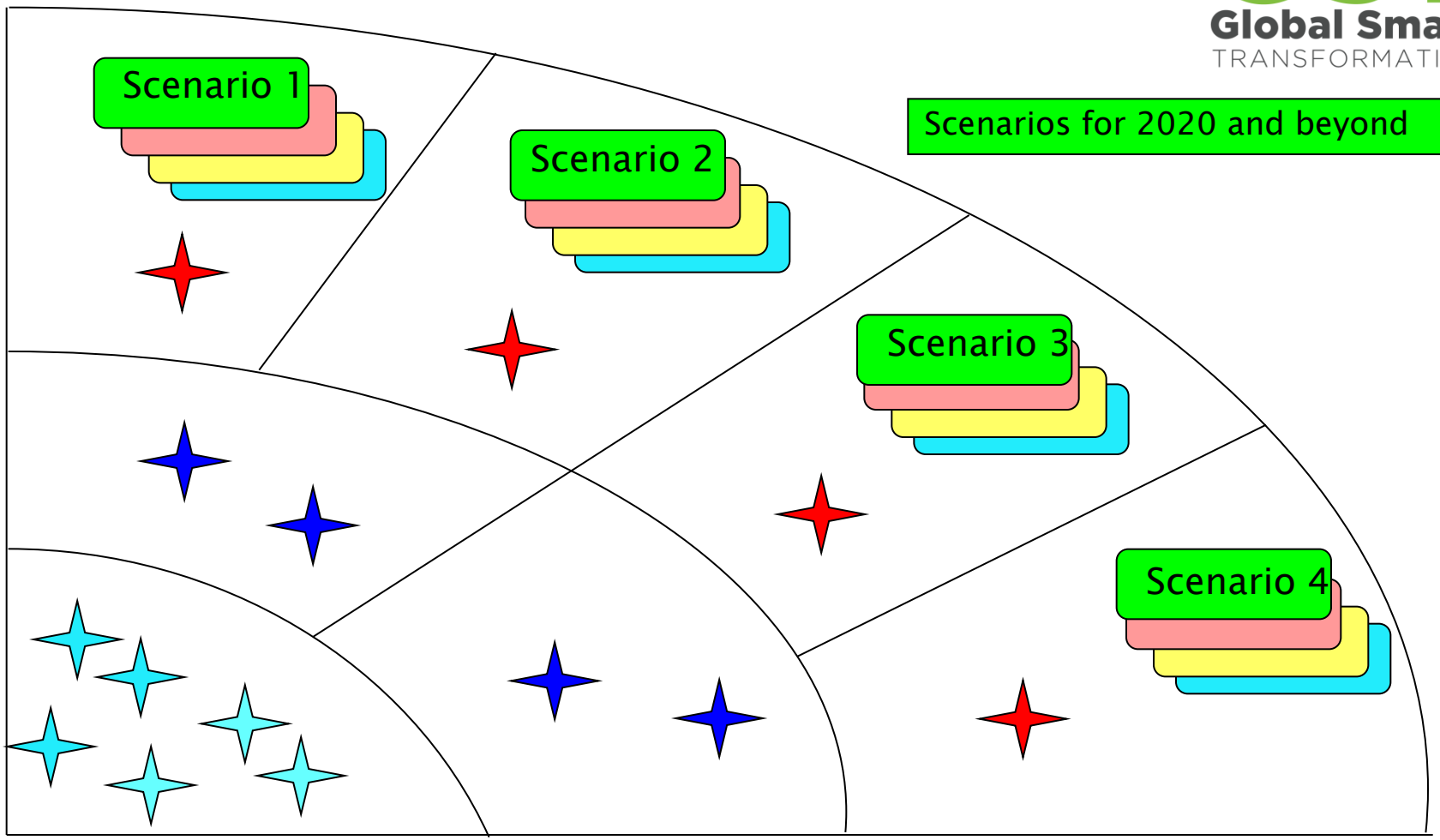


Source: Supergen – University of Strathclyde

Horizon scanning future scenarios



Projects to deliver future benefit in an uncertain future



Legend

- Generic projects that will deliver future benefit across many scenarios
- Broadly focused projects that will deliver future benefit across several scenarios
- Specific projects that will deliver future benefit across particular scenarios

Differences between State Directed / Free Markets

- As globalisation is now a given and most private companies are able to consider which markets that they wish to enter/operate in
  - A geo-political split to supply versus margin is evident
  - Businesses can decide to manufacture, assemble or just supply certain nations needs
  - Local supply / customisation has given-way towards the power of global procurement and the market that can generate
- Different national economies are providing different opportunities and challenges

Liberalised market supply chains

- Due to the fragmented nature of liberalised markets the supply chain is similarly fragmented
- This is often a challenge for the flow of investment due to the benefits not flowing directly to those that invest
- In these cases the benefit flows either up or down the supply chain providing overall benefit but delivering returns to those that have not invested for instance:

Procurement

- A major barrier to innovative new technologies and applications being deployed rapidly is the refined methods of procurement that have evolved
- Given the requirement for new technical, commercial, environmental and cultural outputs to be formed – procurement must deliver the outputs required – not just the lowest cost
- Technical solutions will involve very complex interactions with other stakeholders, procurement processes will need to reflect this

Big versus Small

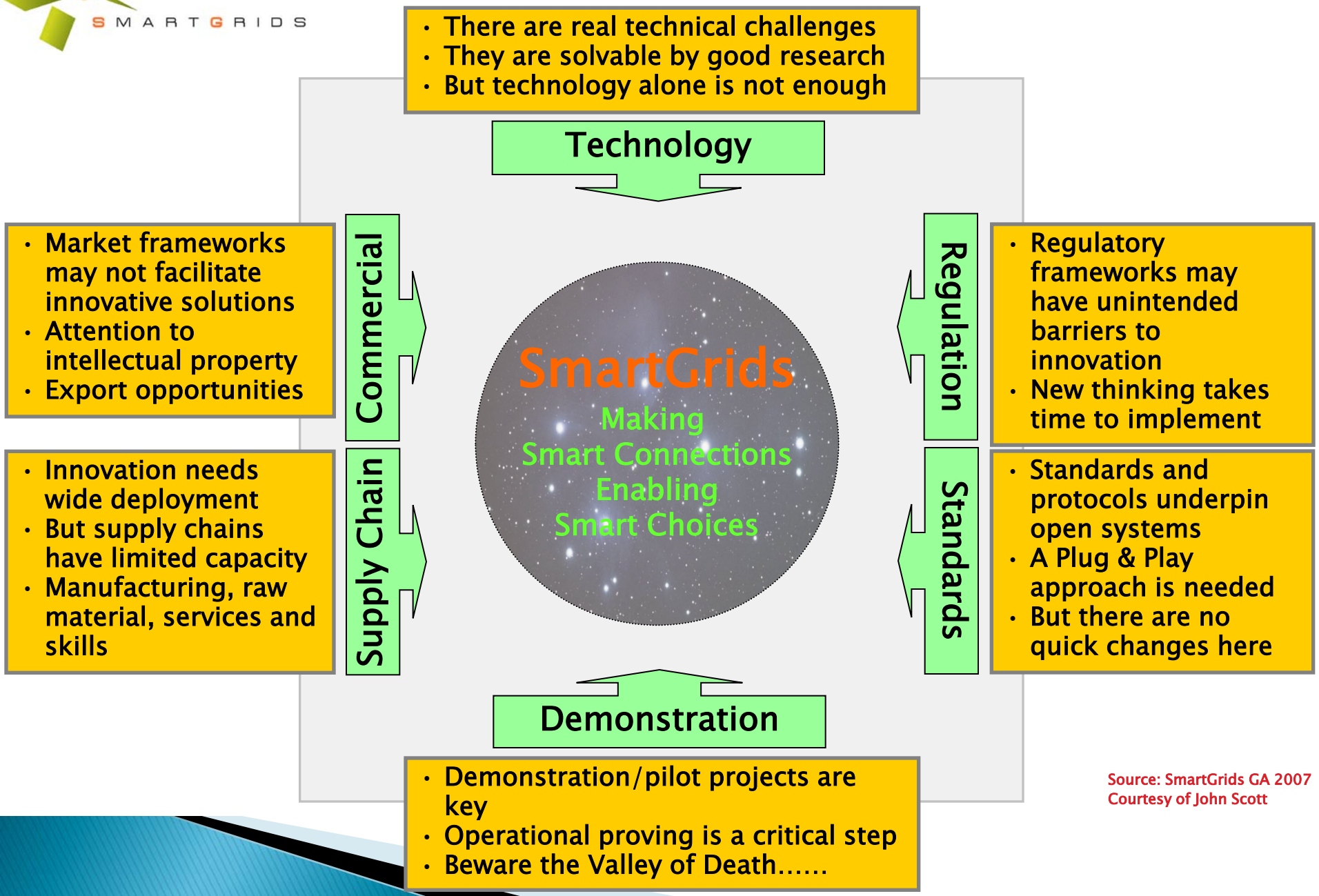
- Innovation nearly always occurs from the small entrepreneurial base rather than the large established businesses
- The Electricity industry has a very high barrier to engagement for the small business to be able to participate. E.g.:
  - The level of risk that the small business is expected to take when bidding against established large conglomerates is exactly the same
  - Procurement requires more than one product with the same functionality to be able to evaluate the lowest cost
  - Delivered products /services must be guaranteed for 10 years, etc

A systemic delivery is required

Here are some important reasons:

- To meet climate change and security of supply targets
- If we are to meet the requirements of an efficient and flexible infrastructure
- To avoid stranded asset utilisation in the future
- To provide the real-time intelligence that will be required for functionality such as adaptive protection, etc (WAMS, WACS and WAPS)
- To enable a step-wise delivery to build towards a coordinated end solution
- To enable individual choices

Making the Business Case – What are the Elements for Success ?



Source: SmartGrids GA 2007
Courtesy of John Scott

Making the Business Case – What are the Elements for Success ?

SMARTGRIDS

- There are real technical challenges
- They are solvable by good research
- But technology alone is not enough

Technology

Commercial

- Market frameworks may not facilitate innovative solutions
- Attention to intellectual property
- Export opportunities

Regulation

- Regulatory frameworks may have unintended barriers to innovation
- New thinking takes time to implement

Supply Chain

- Innovation needs wide deployment
- But supply chains have limited capacity
- Manufacturing, raw material, services and skills

Standards

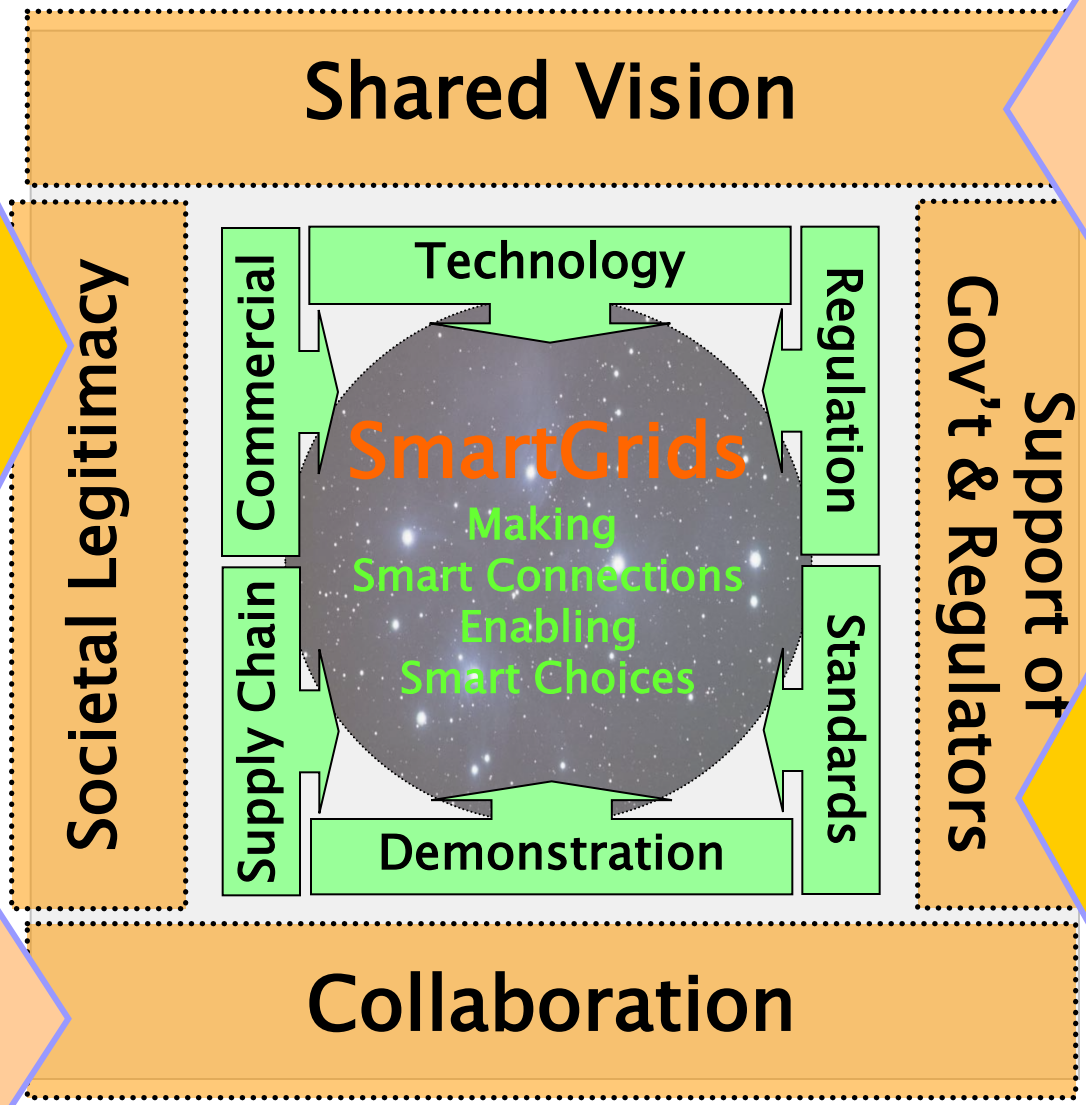
- Standards and protocols underpin open systems
- A Plug & Play approach is needed
- But there are no quick changes here

Demonstration

- Demonstration/pilot projects are key
- Operational proving is a critical step
- Beware the Valley of Death……

Source: SmartGrids GA 2007
Courtesy of John Scott

…. and what framework do they sit within ?



- Multiple parties must form a common view of success
- A shared and living Vision is a must for 'joined up thinking'

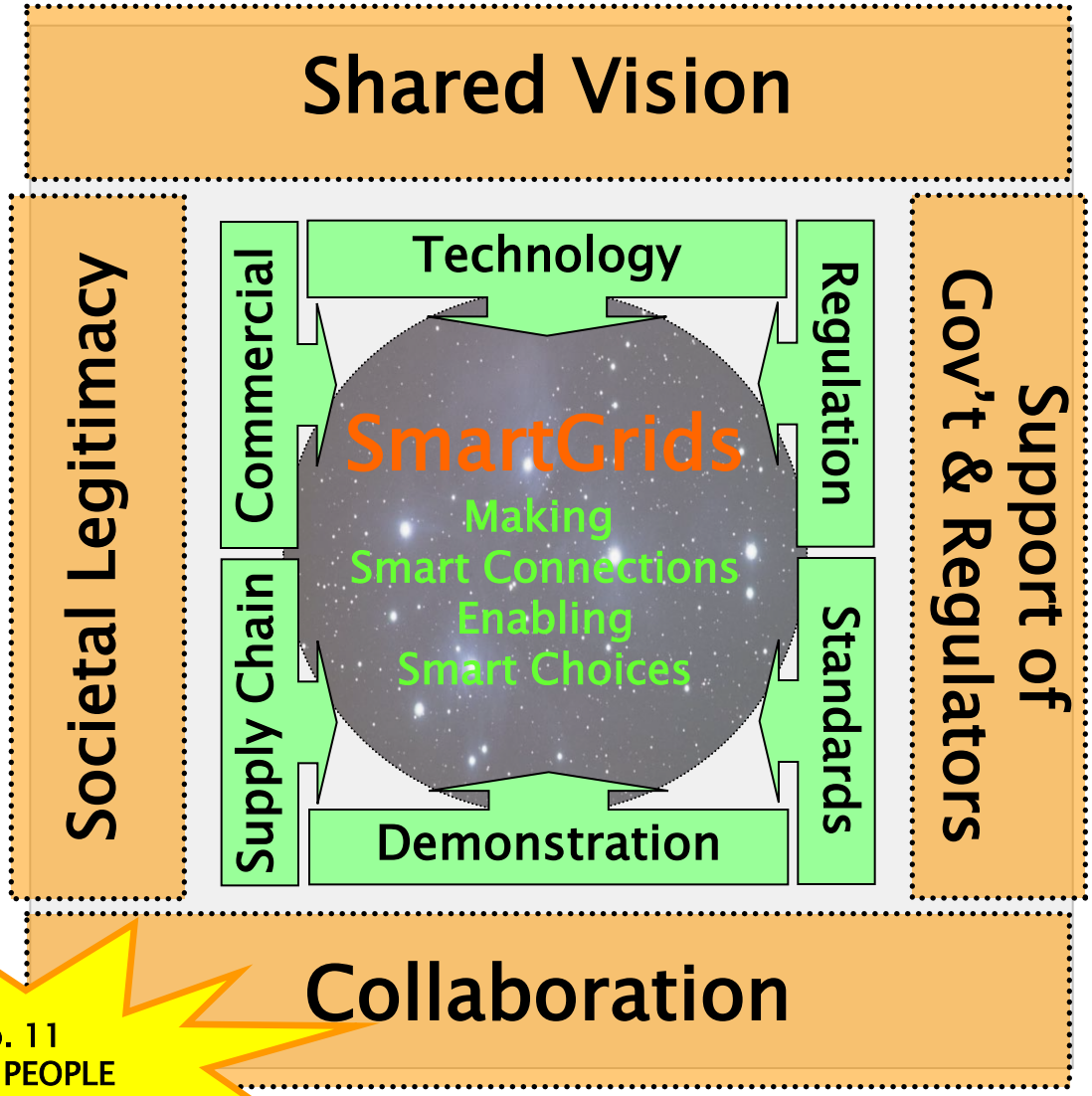
- Consents for development will be needed; also
- *Permission to Operate* in the wisest sense
- Trust & social impact requires special attention

- Major change requires shared priorities and co-operation
- Especially for framework changes and between different sectors

- Collaborative working underpins integration & efficiency
- It is the way a market handles complexity

Source: SmartGrids GA 2007
Courtesy of John Scott

The 10 Elements for Success



and No. 11
IT'S ONLY PEOPLE
THAT GET THINGS
DONE – SKILLS?

Source: SmartGrids GA 2007
Courtesy of John Scott

Thank you for your attention!
Q&A

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