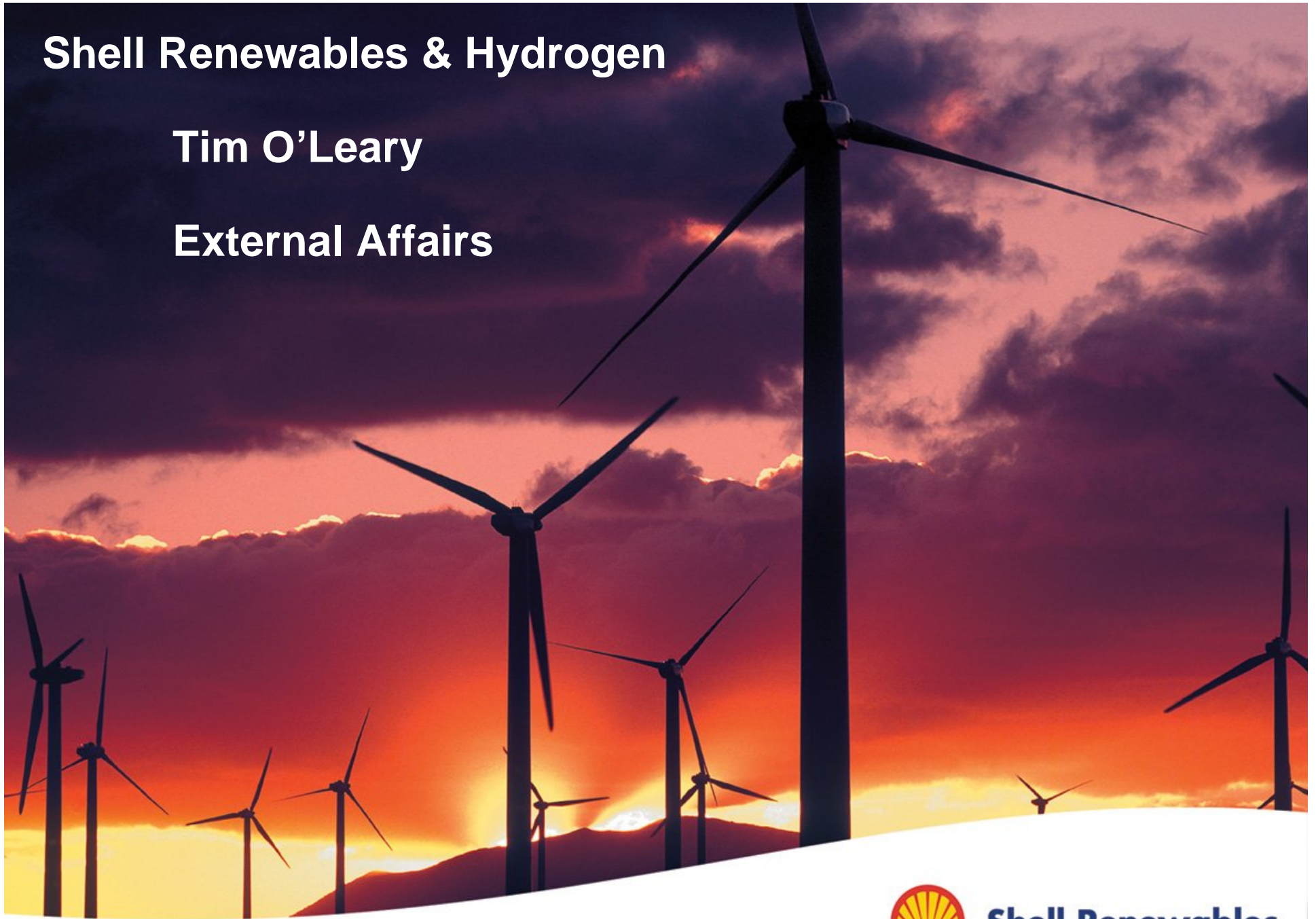


# Shell Renewables & Hydrogen

Tim O'Leary

External Affairs

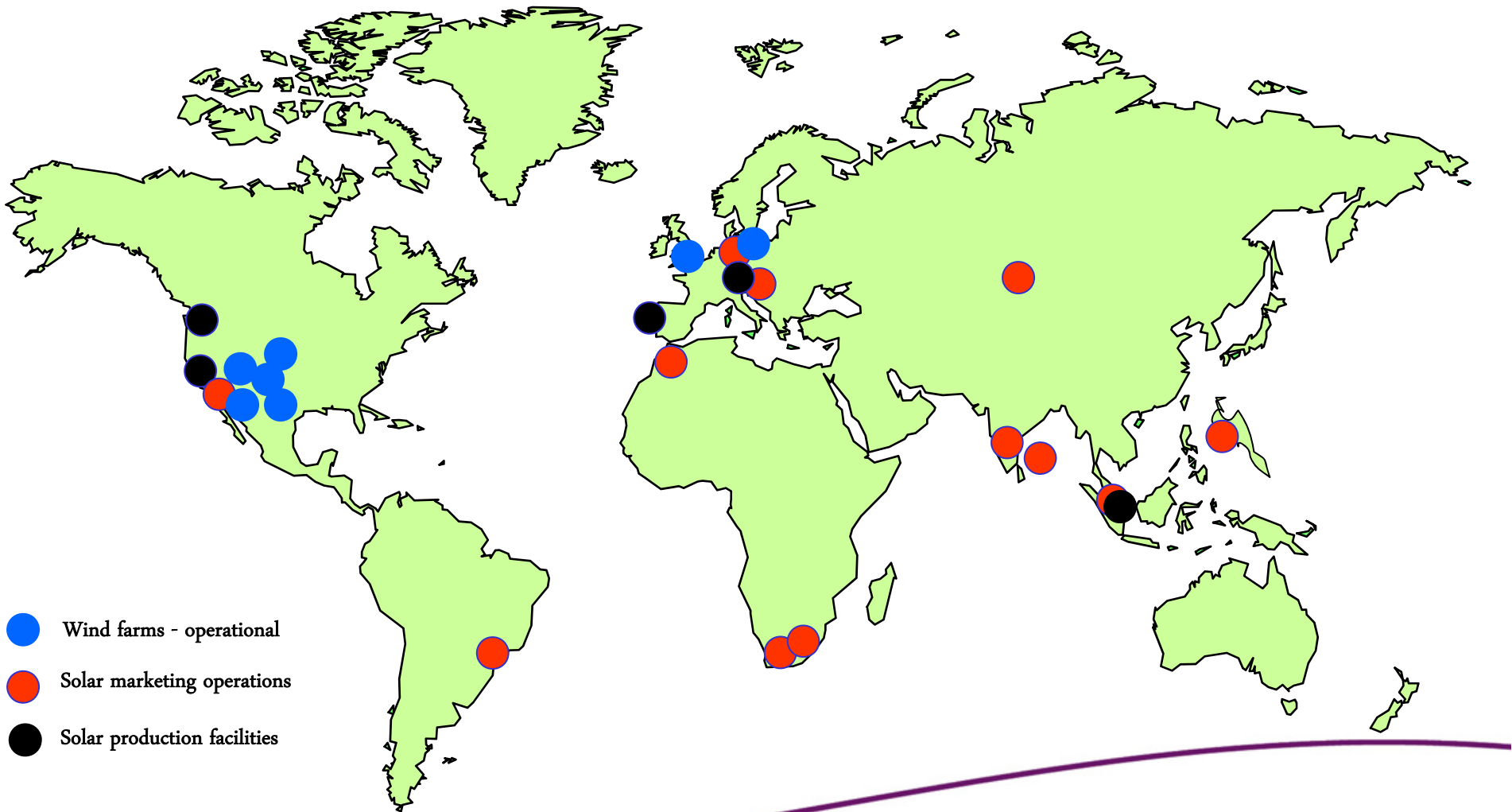


**Shell Renewables**

# A global presence

Shell Renewables: 1,100 employees

90 Countries



- Wind farms - operational
- Solar marketing operations
- Solar production facilities



**Shell Renewables**

# Why Shell?

Shell is an....

Energy, Mobility and Petrochemicals Co.



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# Shell's Vision for Future Energy Products

## The Future Energy Mix

- Cleaner crude-based fuels – gasoline and diesel
- Clean hydrocarbon liquids derived from natural gas (GtL technology)
- Compressed Natural Gas (CNG)
- Liquefied Petroleum Gas (LPG)
- Bio-fuels
  - Bioesters
  - Ethanol
- Shell Solar
- Shell Wind
- Shell Hydrogen



Shell Renewables

# Shell Renewables

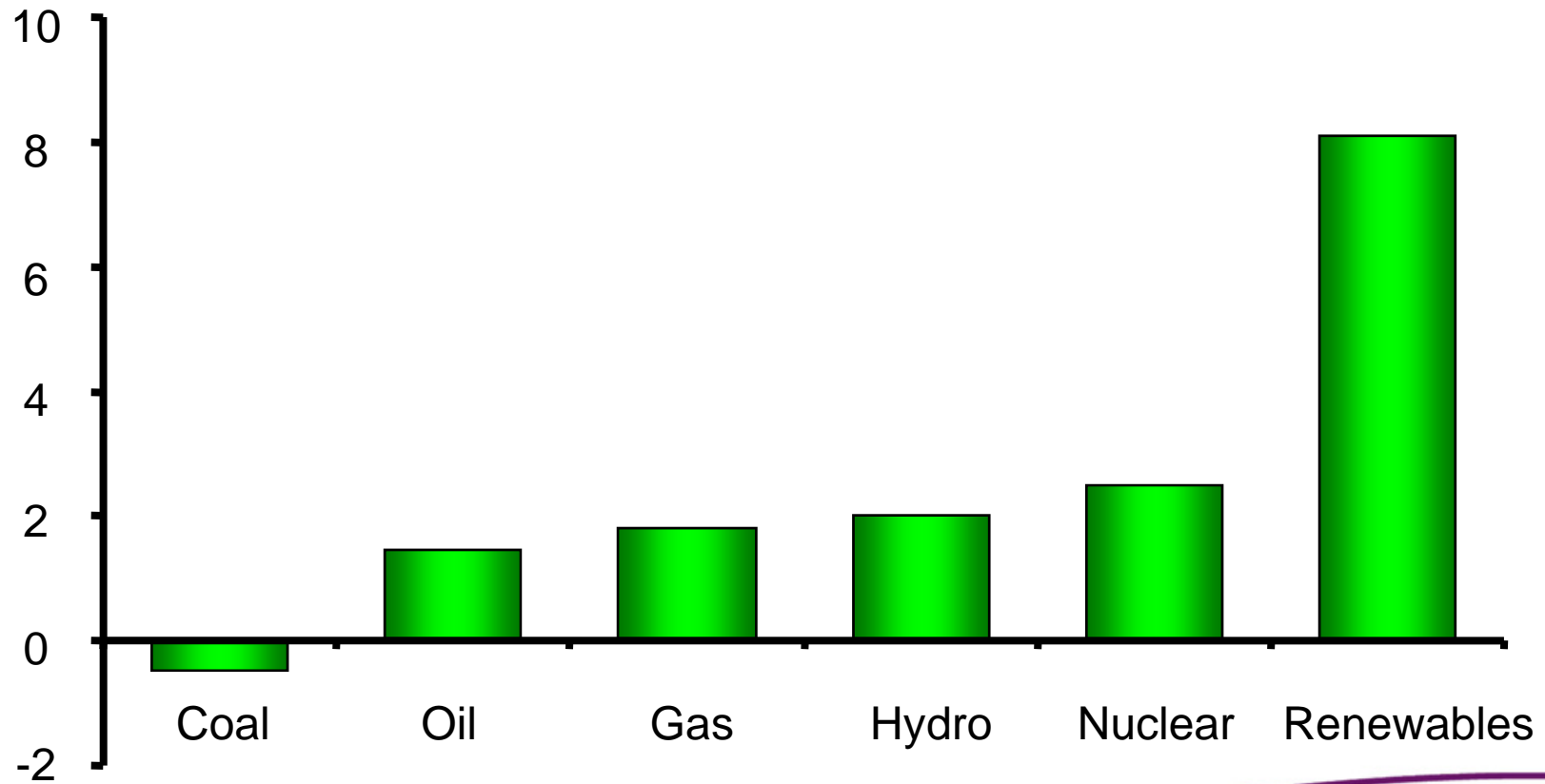
- Renewables are the fastest growing source of primary energy
- Most comprehensive “new energy” portfolio in the industry
- Sufficient to meet energy requirements of entire planet
- Could supply a third of primary energy by 2050
- Shell’s invested over \$500 million in 5 years to 2002
- Investing further \$500 million to 2005



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# Faster growth than conventional energy...

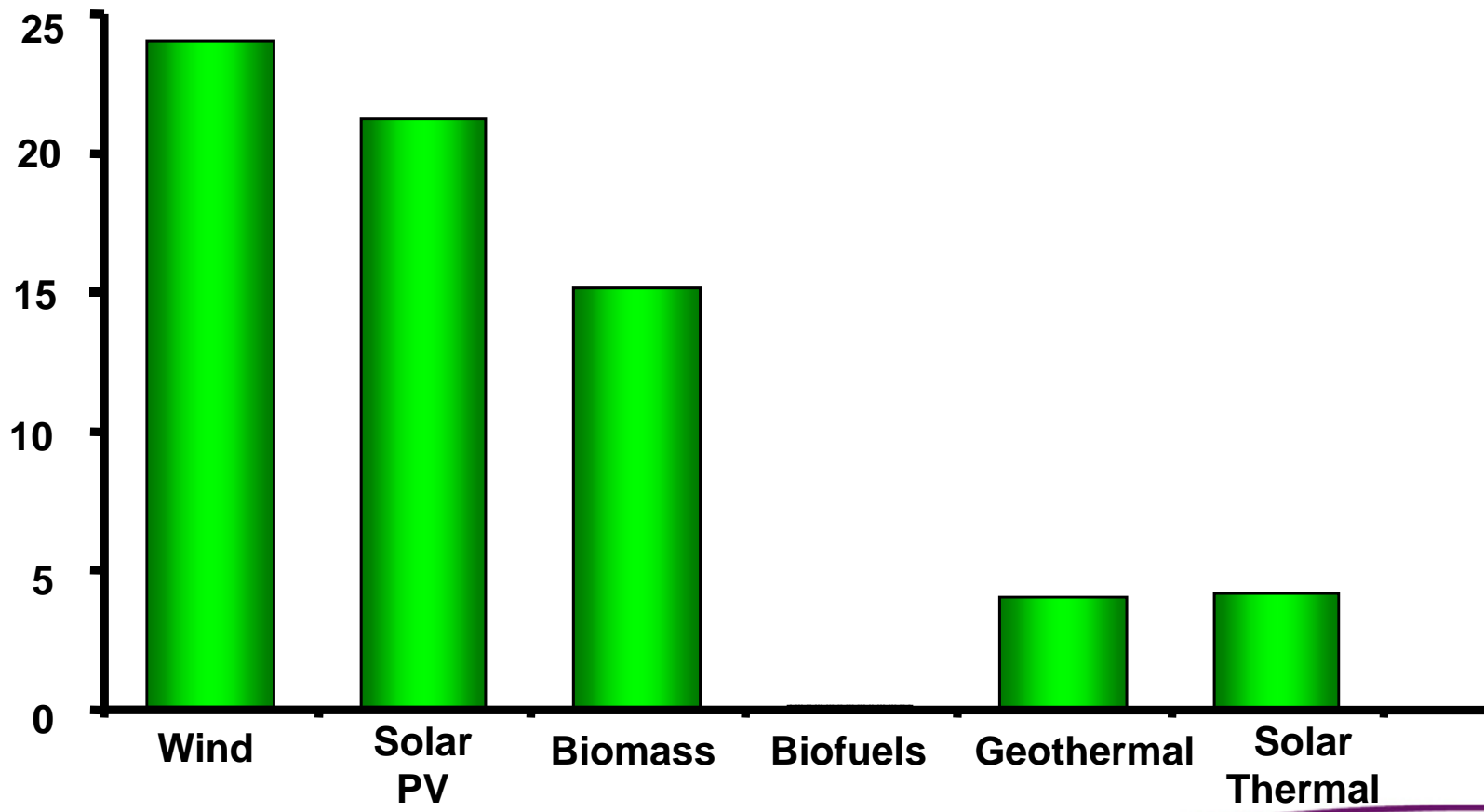
1990-2000  
growth (% pa)



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# ...with fastest growth in wind and solar

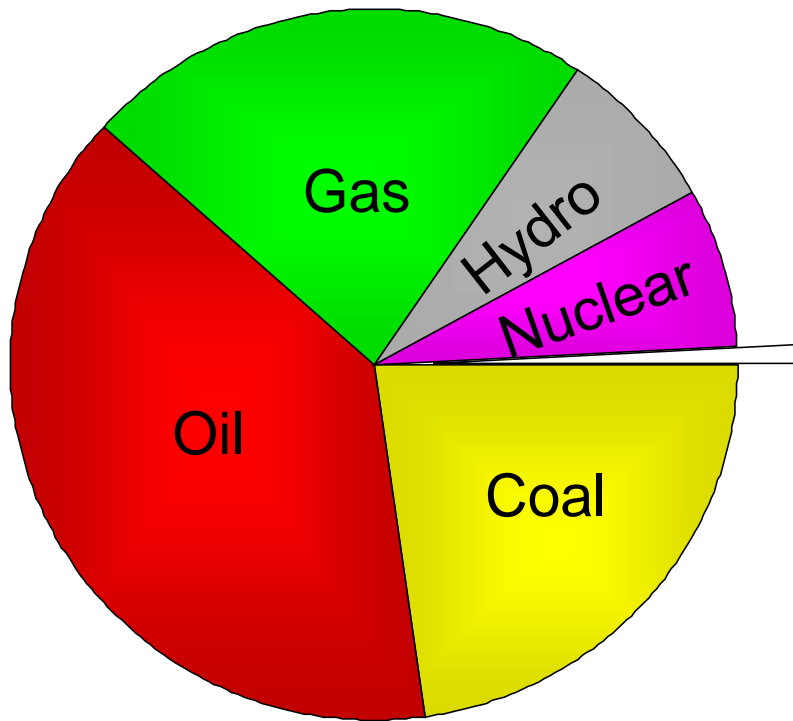
1990-2000  
growth (% pa)



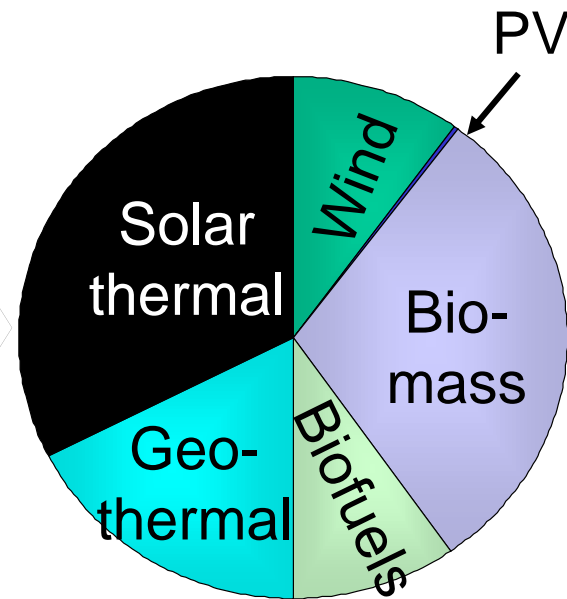
# A small but growing share of primary energy

Total primary energy:  
114'000TWh/year

Renewables: 1'100TWh/year



Renewables



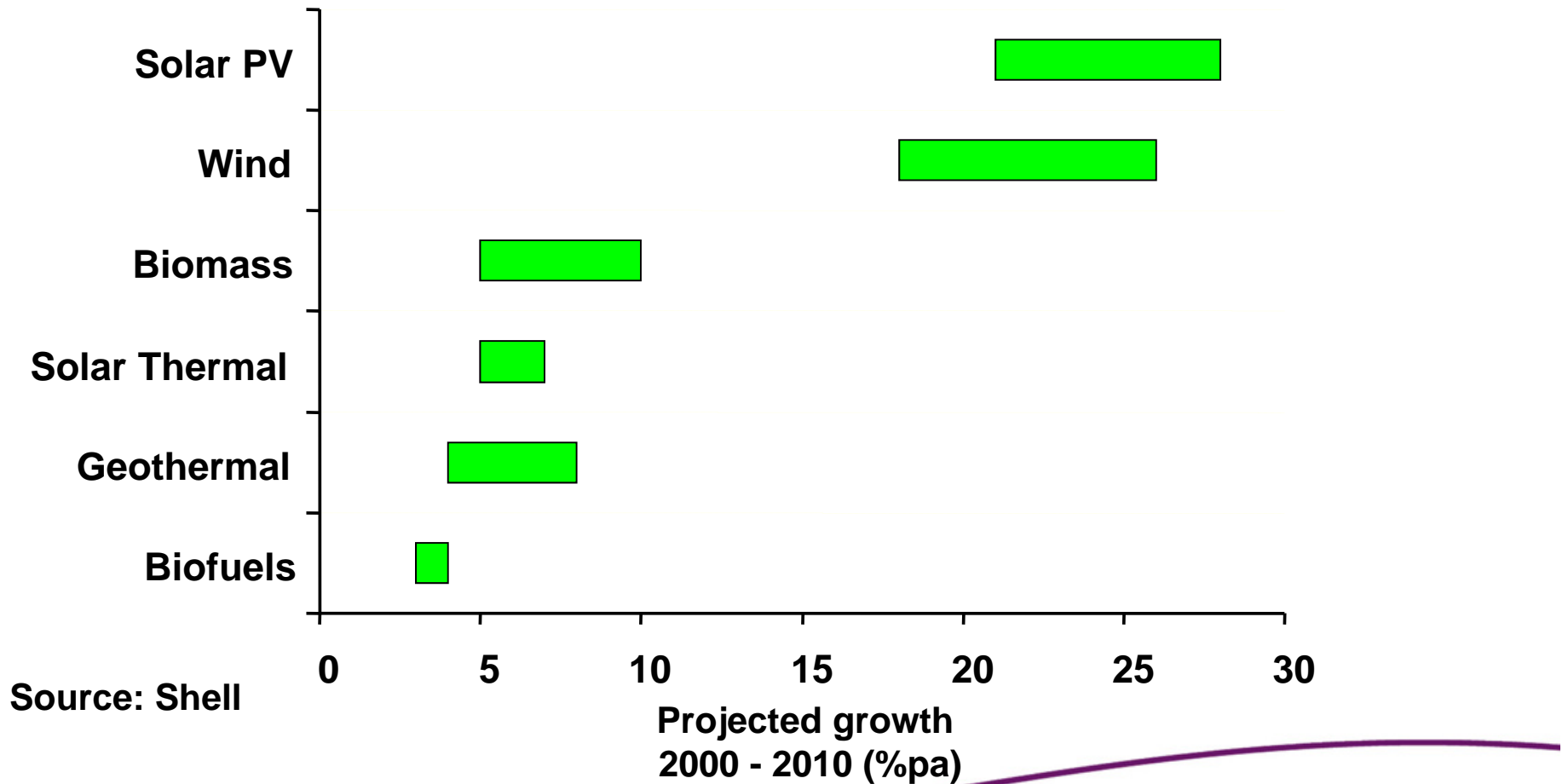
Energy mix



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# Continued strong growth ahead



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# What Shapes Long Term Energy?

## The contributors

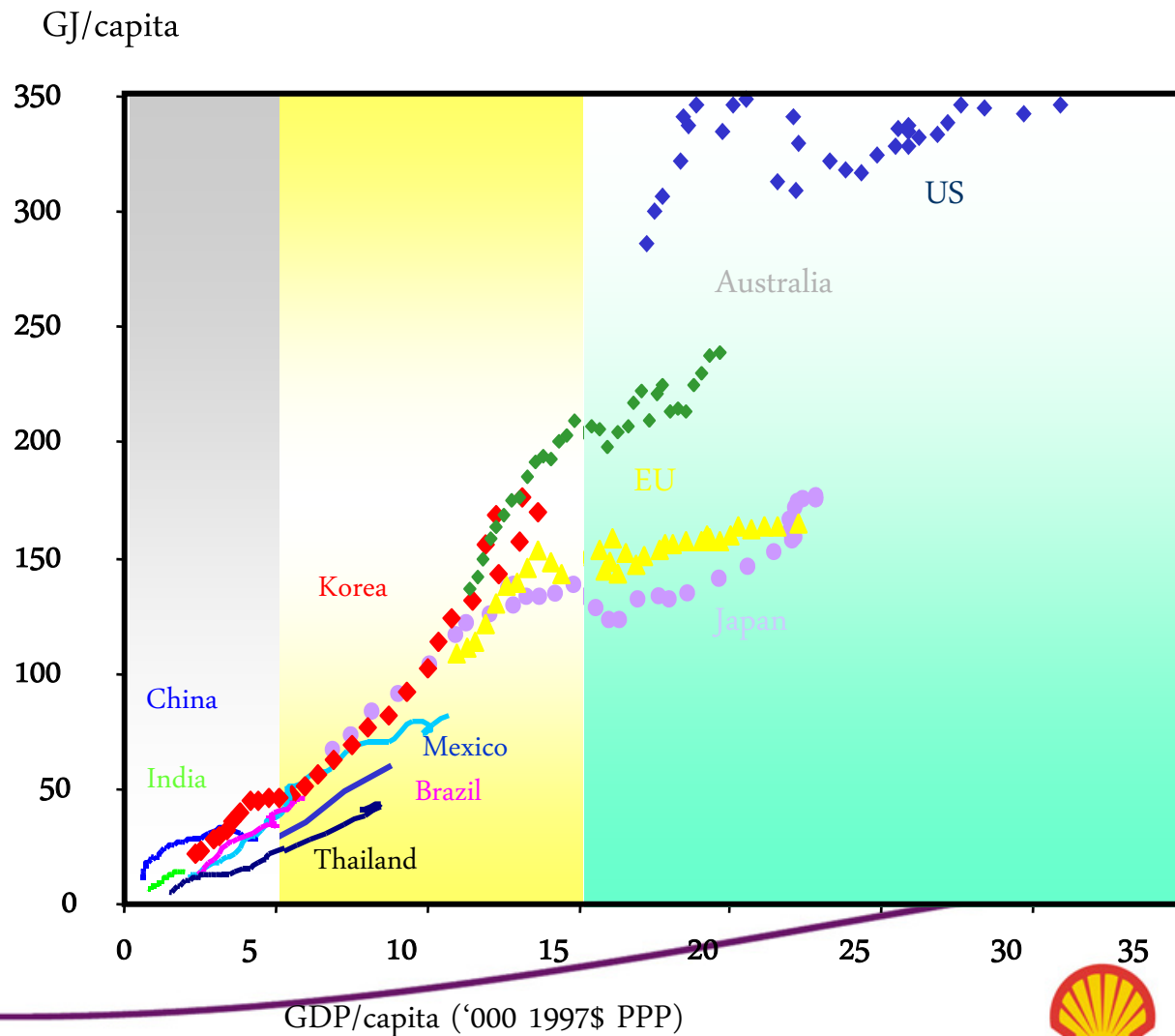
By 2050

- demography: 8-10 billion people
- incomes: average \$15-25k/capita
- urbanisation: 80% living in cities
- liberalization: markets increase possibilities
- demand (2-3 times increase)



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# Climbing The Energy Ladder A Continuously Changing Relationship



- +\$25k/capita:  
little extra energy needed.
- +\$15k/capita:  
services start to dominate growth.
- +\$10k/capita:  
industrialization near complete.
- +\$5k/capita:  
industrialization and mobility take off.

Source: IMF, BP



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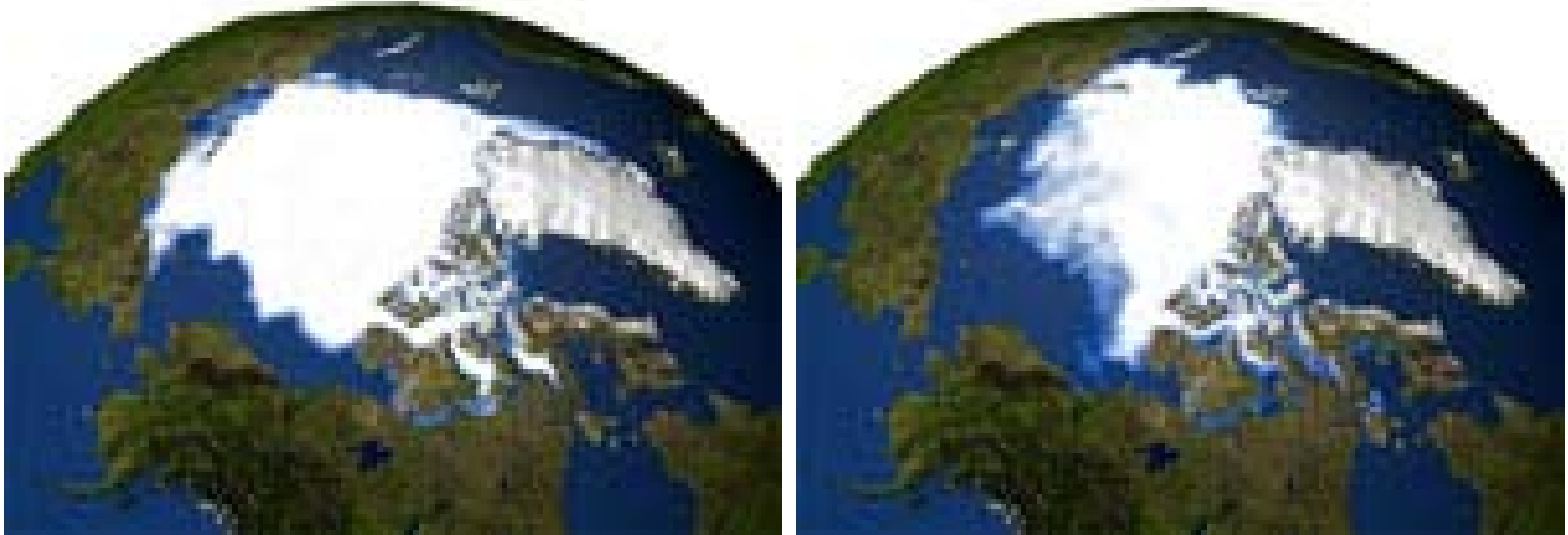
# Shell's Views on Climate Change

- Shell shares the widespread concern that GHGs from human activities are leading to changes in the global climate.
- We support the aim of stabilizing concentrations of greenhouse gases in the atmosphere.
- We believe action is required now. Shell has exceeded its '02 target to reduce emissions by 10% (vs '90); We support:
  - ✓ A stable, moderate and widely inclusive policy regime
  - ✓ New lower carbon technologies
  - ✓ International cooperation and international agreements
  - ✓ Involving developing countries
  - ✓ Flexible market mechanisms like “cap and trade” systems
  - ✓ Efficient energy use by consumers
  - ✓ NG as an enabler to lower carbon intensity economic growth.
  - ✓ A “well-to-wheels” perspective of emissions



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# Climate Change

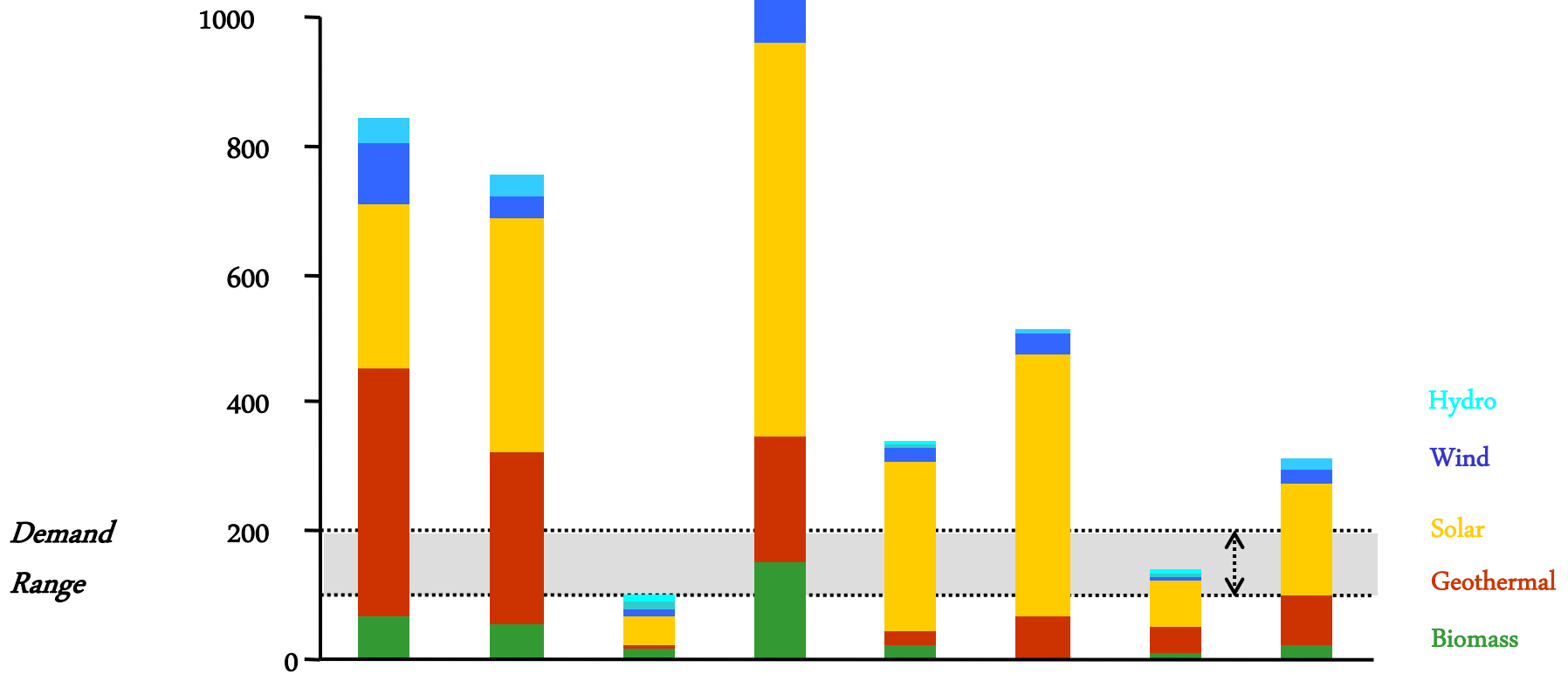


- “sea ice in the Arctic is declining at a rate of nine percent per decade”  
“the rate of warming in the Arctic over the last 20 years is eight times the rate of warming over the last 100 years”
- UNFCCC (1992) and Kyoto Protocol (1997) aiming to address the issue



# Renewable Resources are Adequate to Meet all Energy Needs

GJ per capita



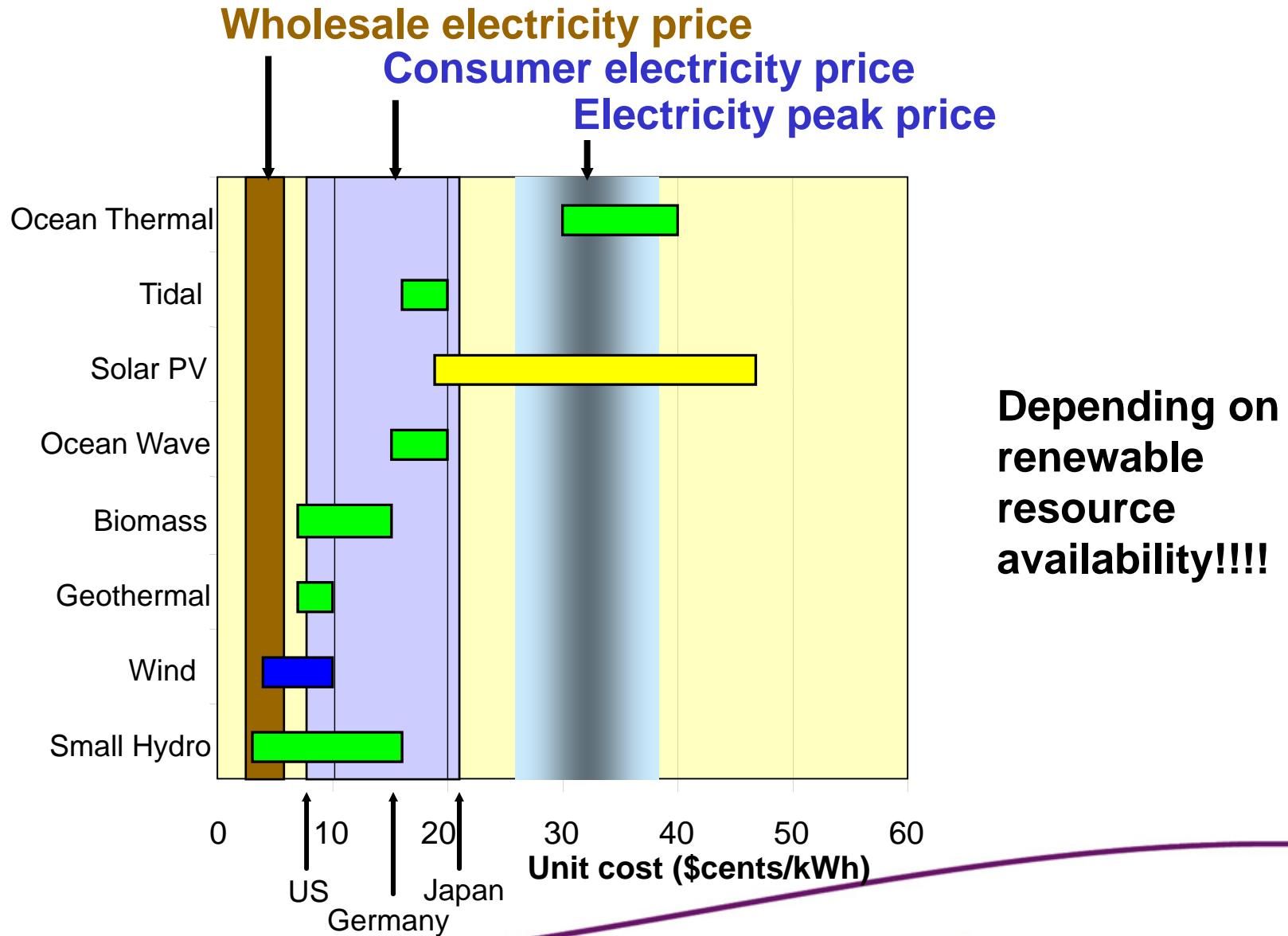
Sourced/adapted from UN 2000, WEC 1994, and ABB 1998.

Figures based on 10 billion people.



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# Renewables already compete with retail power



cost competitiveness (excluding subsidies)



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## Shell Solar

- Supplied over 20% (+350MW) global installed solar capacity
- Historic Leader in U.S. with approx. 25% market share
- Asia Pacific office established in 1981
- Leading PV supplier in China
- Applications range from rural village projects to 5MW project on a brownfield in Germany
- 1300 people across 75 countries



**Shell Renewables**





**Shell Renewables**

## Shell Wind

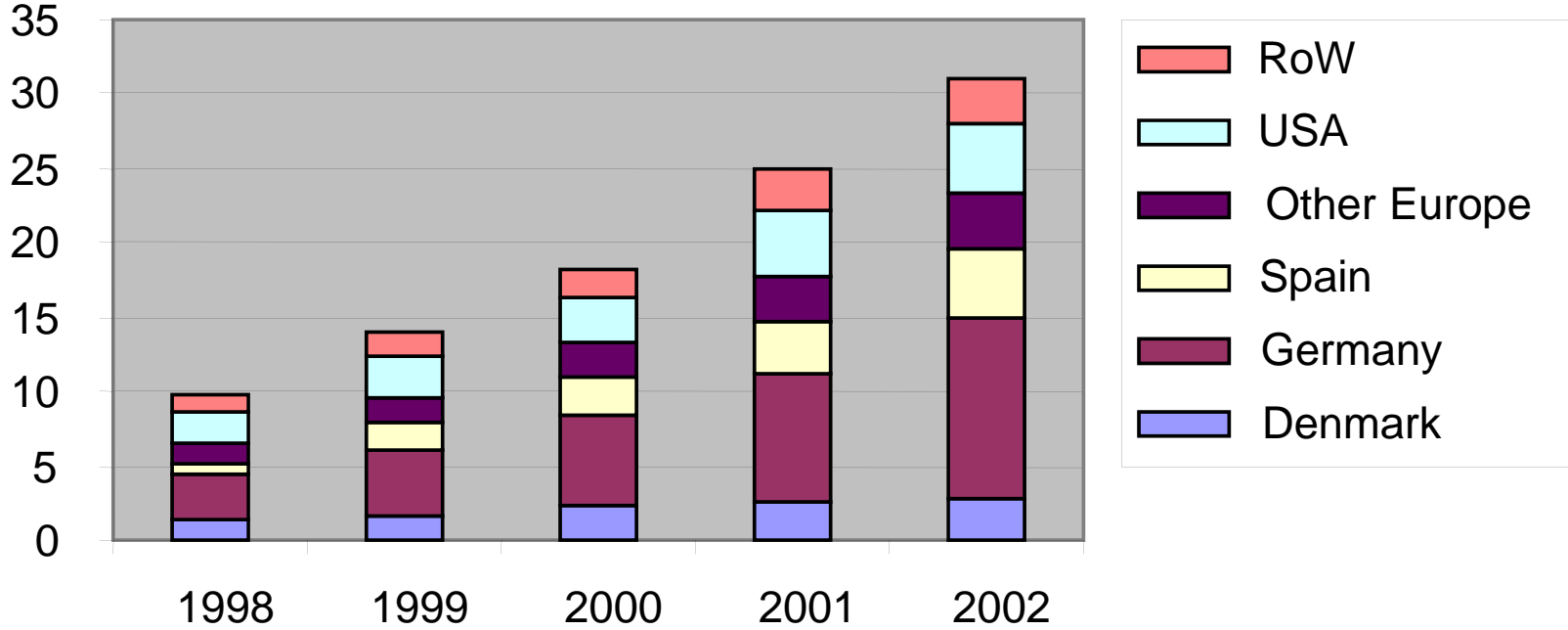
- US/EU focus - No. 2 Wind player in the U.S.
- Serving almost 100,000 U.S. homes
- 8 wind parks: 500 MW capacity
- 35% CAGR over the past five years
- Growth momentum dependent on extension of support regimes



**Shell Renewables**

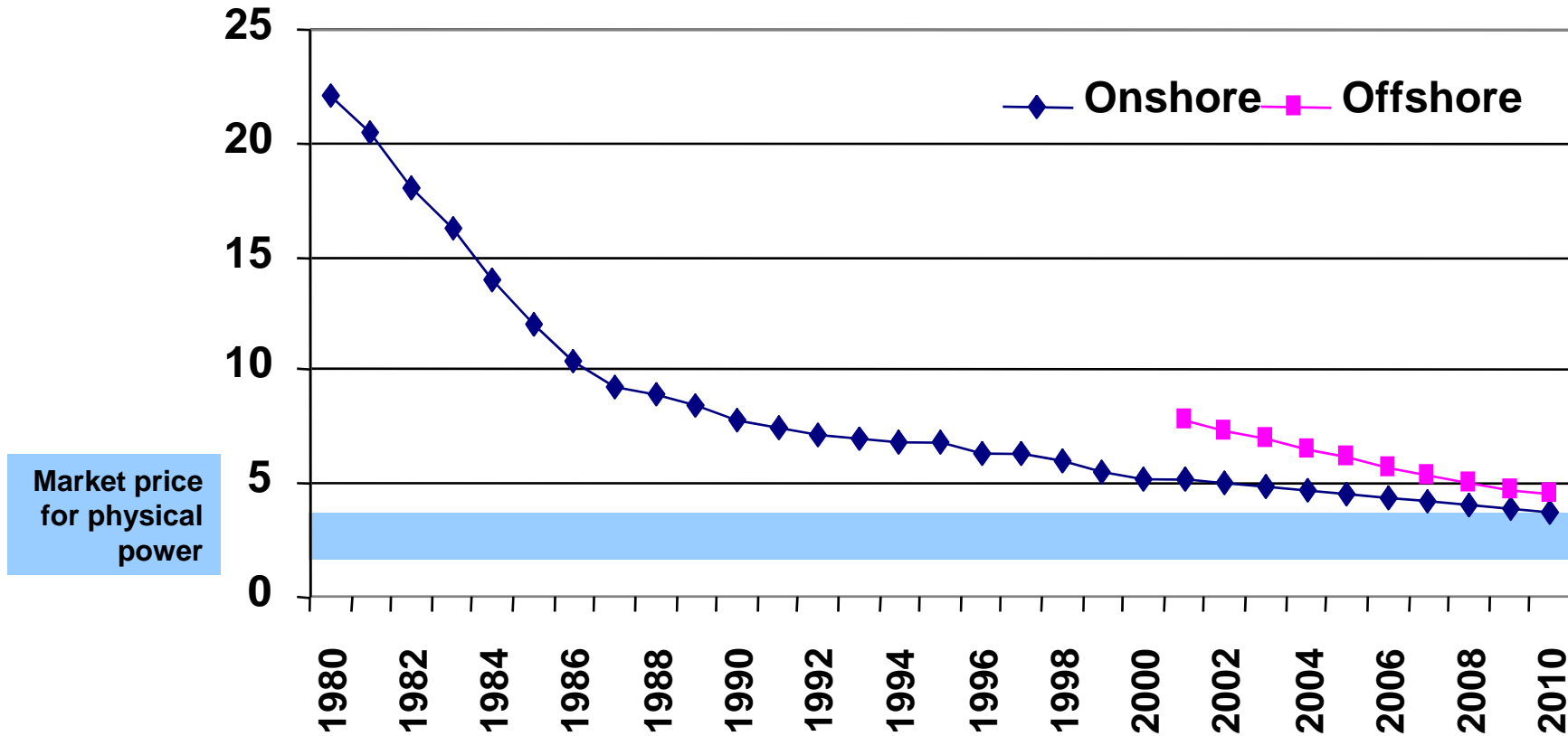
# Wind market growth

## Installed Wind Capacity (in GW)



# Future cost competitiveness of wind energy

Cost of wind-generated electricity (\$¢/kWh)



for a site with 8-9 m/s average annual wind speed



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# Shell WindEnergy Operational Projects



Harburg Germany 4MW



Blyth Offshore UK 4MW



White Deer Texas 80MW



Cabazon Pass California 41MW



Whitewater Hill California 60 MW



Rock River Wyoming 50MW

- End 2003 installed capacity = c. 500 MW



Shell Renewables

## Shell's strategy for renewables / hydrogen

- Renewables have made significant progress over past decades and show strong potential for the future.
- Positioning for rapidly changing market - focusing on commercial renewables...progressing Hydrogen, Hot Fractured Rock, biofuels
- Building on distinct experience / capabilities
- Potential can only be realized by governments and private sector working together.



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# Why Hydrogen?

- **Hydrogen is a convenient energy storage medium (not a primary source of energy)**
- **Hydrogen is clean – in either ICE or Fuel Cell or in Power Generation**
- **Can be used to store energy from intermittent sources like wind, solar, geothermal**
- **Can be produced from fossil fuels and biomass via chemical conversion processes**
- **Can be produced from renewable sources via electrolysis**



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## Shell is already experienced in producing and handling H<sub>2</sub>

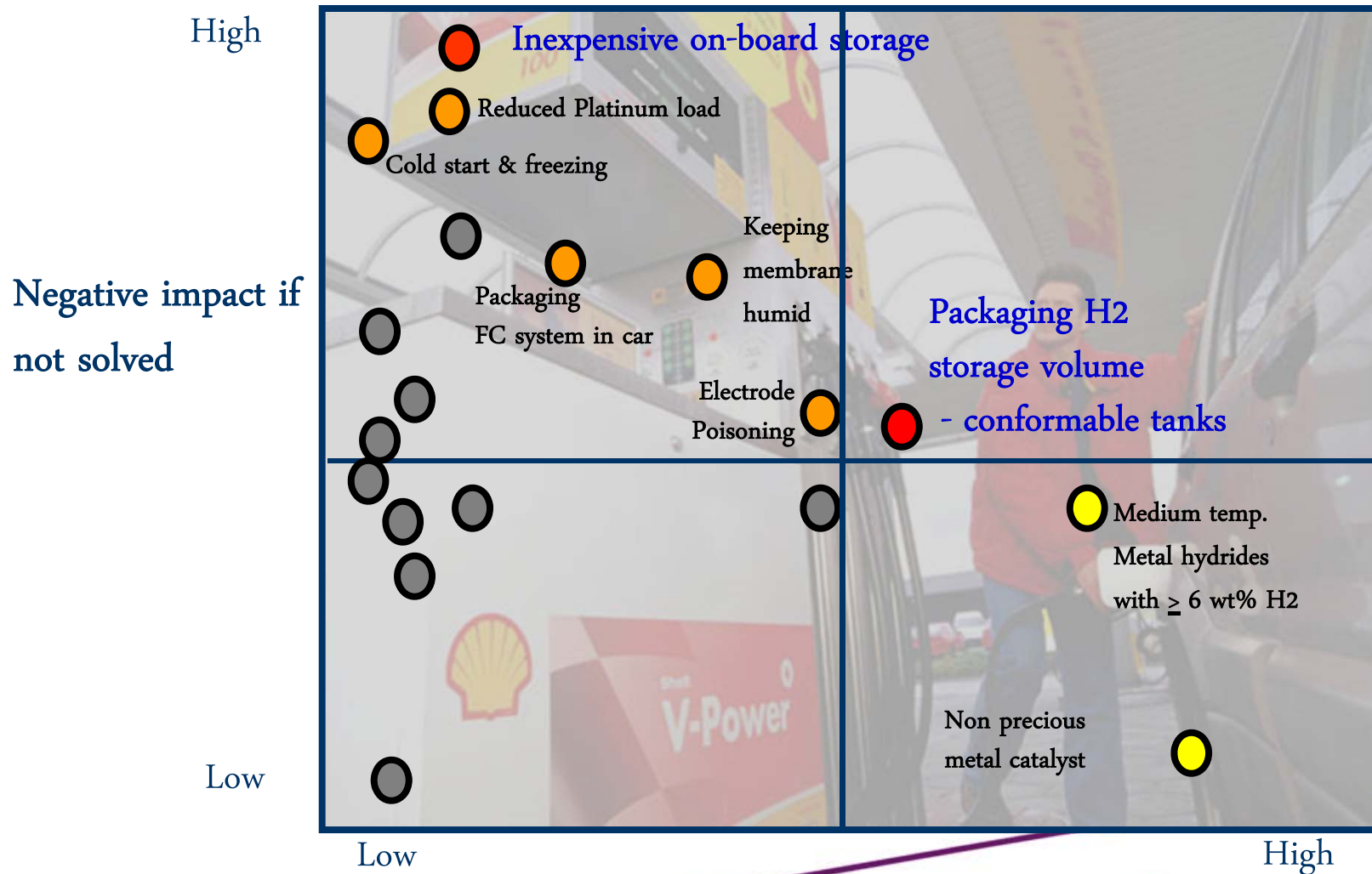
- Experienced at H<sub>2</sub> production: Shell is experienced in the safe and productive handling of H<sub>2</sub> & traditional fuels
- Shell is the 4<sup>th</sup> largest producer of hydrogen and has been producing H<sub>2</sub> for over 40 years
- Shell is leveraging the most cost-effective, safe and available infrastructure to address the security, supply and responsible acceleration of the hydrogen industry
- Shell is well connected to advance a greener hydrogen economy via Wind, Solar



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# Technical issues to be addressed for a transportation based on hydrogen



Remaining technical hurdles



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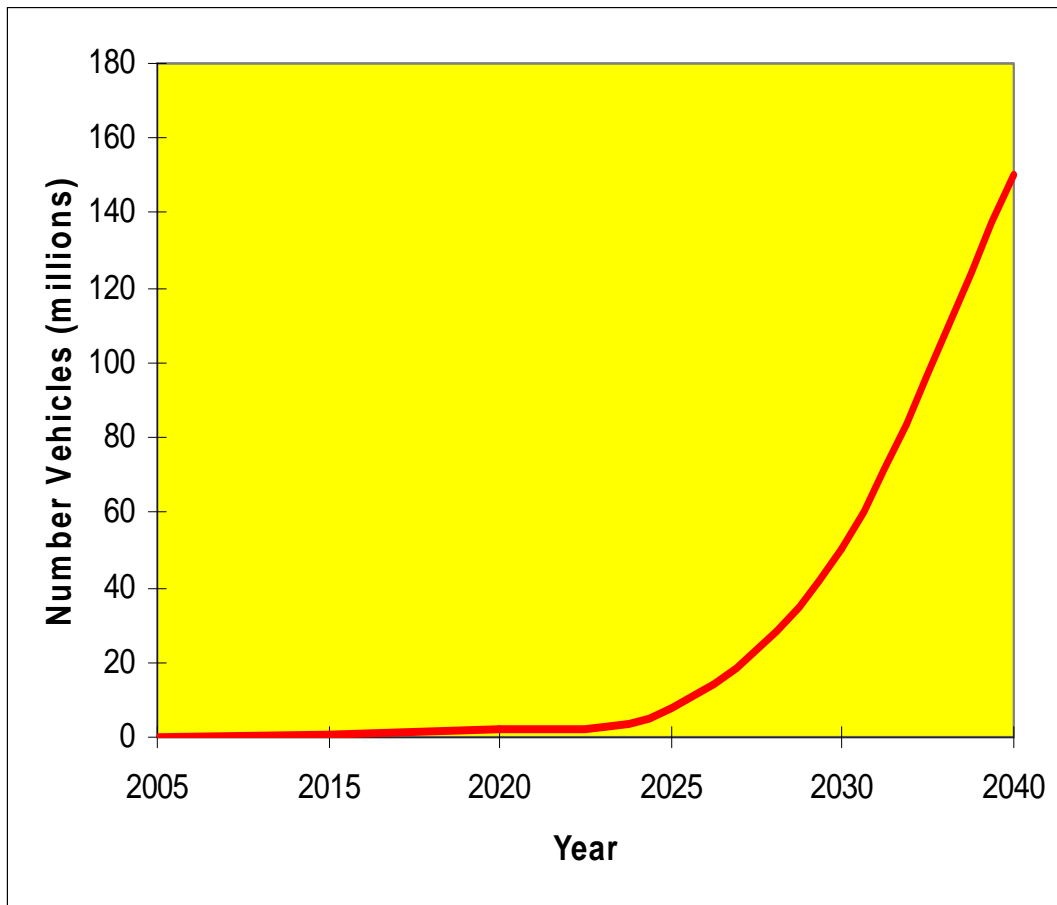
# Hydrogen Refueling Demo's

- Japan
- Iceland
- Europe
- North America



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# Our Vision for H2 Market Takeoff



- Growth of H2 Market will depend on funding the transition to mass production
  - Dependent on public policy developments – incentives
- Future landscape is being shaped now
  - Players developing H2 policies and positions
- Historical examples
  - Personal computers
  - Mobile phones



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# Shell Hydrogen Vision

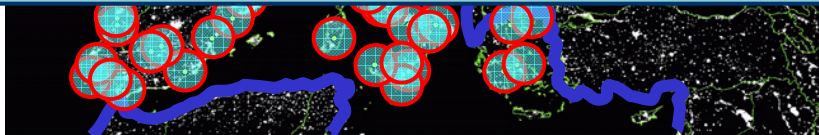
- Stand alone projects – hydrogen-fuelled buses out of depots (e.g. Amsterdam and Luxembourg)
- Second generation sites, with public access, but separate from existing fuel stations (e.g. Iceland station)
- Fully integrated hydrogen and gasoline fuel stations (e.g. Benning Road Shell Station in Washington DC)
- Within next 5 years – Lighthouse projects: integrated stations within mini-networks
- 2010 – 2020 connecting the mini-networks with corridors and filling the white spaces



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### A new approach: Mini Networks



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# Shell – positioning for the future

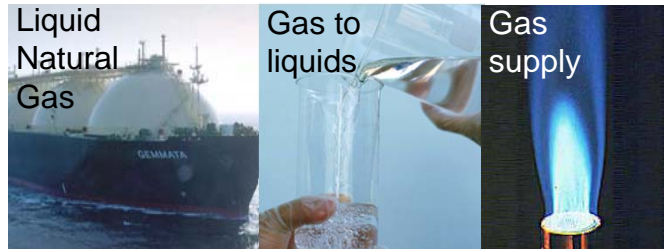
## Hydrogen

Developing tomorrow's hydrogen infrastructure.



## Wind

Powering hundred of thousands of homes with Wind energy.



## Natural gas

World leader in LNG;  
Making cleaner transport fuels with 'gas to liquids' technology.

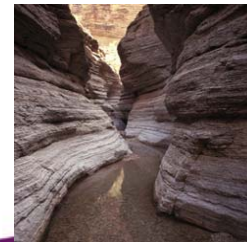


## Solar PV

Making the world's most energy efficient commercial solar panels.

## Bio-products

One of the world's largest bio-fuel users today;  
Researching advanced bio-products for tomorrow.



## Geological sequestration

Partnering in research and development initiatives



**Shell Renewables**