



Shell Energy Scenarios & Hydrogen

Royal Dutch/Shell Group

Alpbacher Technologie Gespräche 2005

What Shapes Long Term Energy?

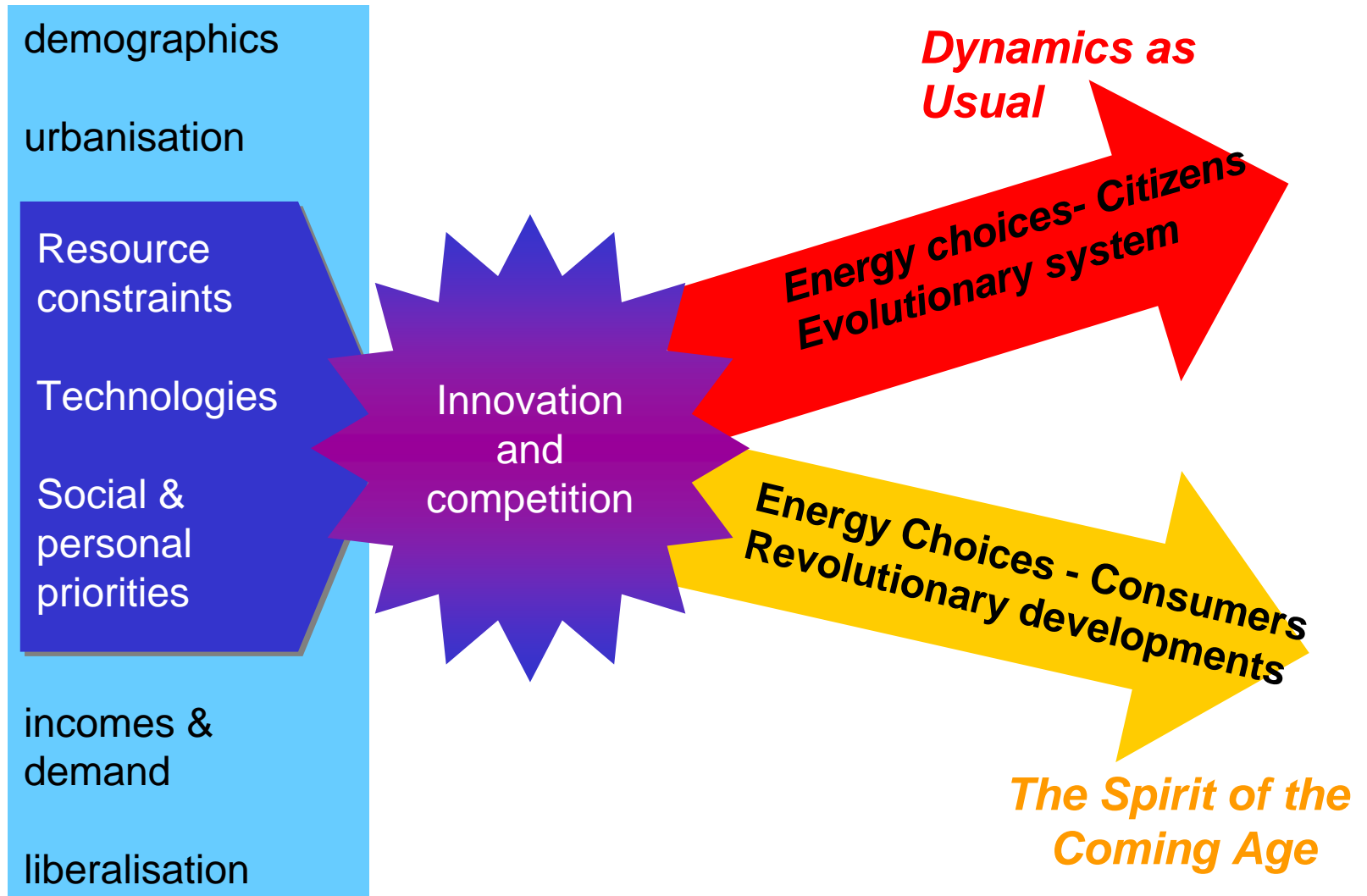
The contributors

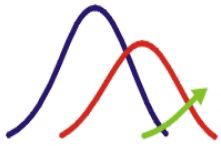
- demography
- incomes
- urbanisation
- liberalisation

The critical

- resource constraints
- technology
- social and personal priorities

Energy Branching Points

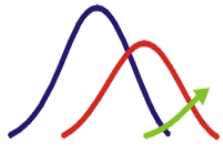




Dynamics as Usual

Societal pressures for “clean”, “secure” and “sustainable” energy push a direct path to renewables, supported by gas in the medium term

But only after advances in energy storage and a next generation of renewables around 2025. Vehicle efficiency advances prolong the oil transition.



“Rumors of my death are greatly exaggerated”
Mark Twain

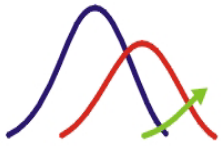
80 mpg Direct Injection



A New Life for Internal
Combustion Engines



60 mpg Hybrid



Long Term Renewables wins

Thin film Solar

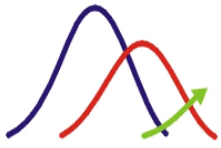


Biofuels



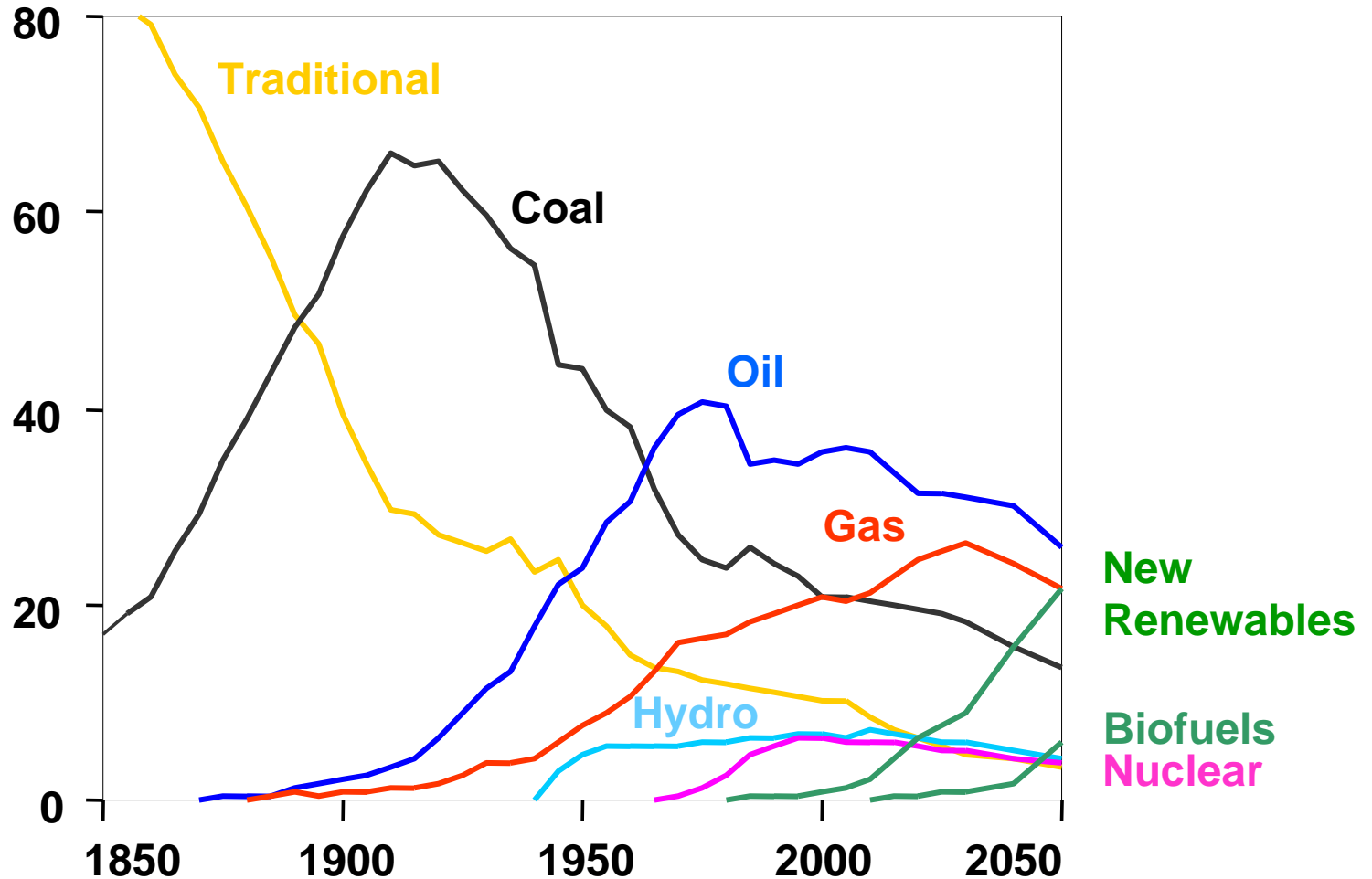
Diverse Storage

- Thermal
- Pumped hydro
- Compressed air
- Chemical



Energy Transitions *Dynamics as Usual*

% of Primary Energy





Spirit of the Coming Age

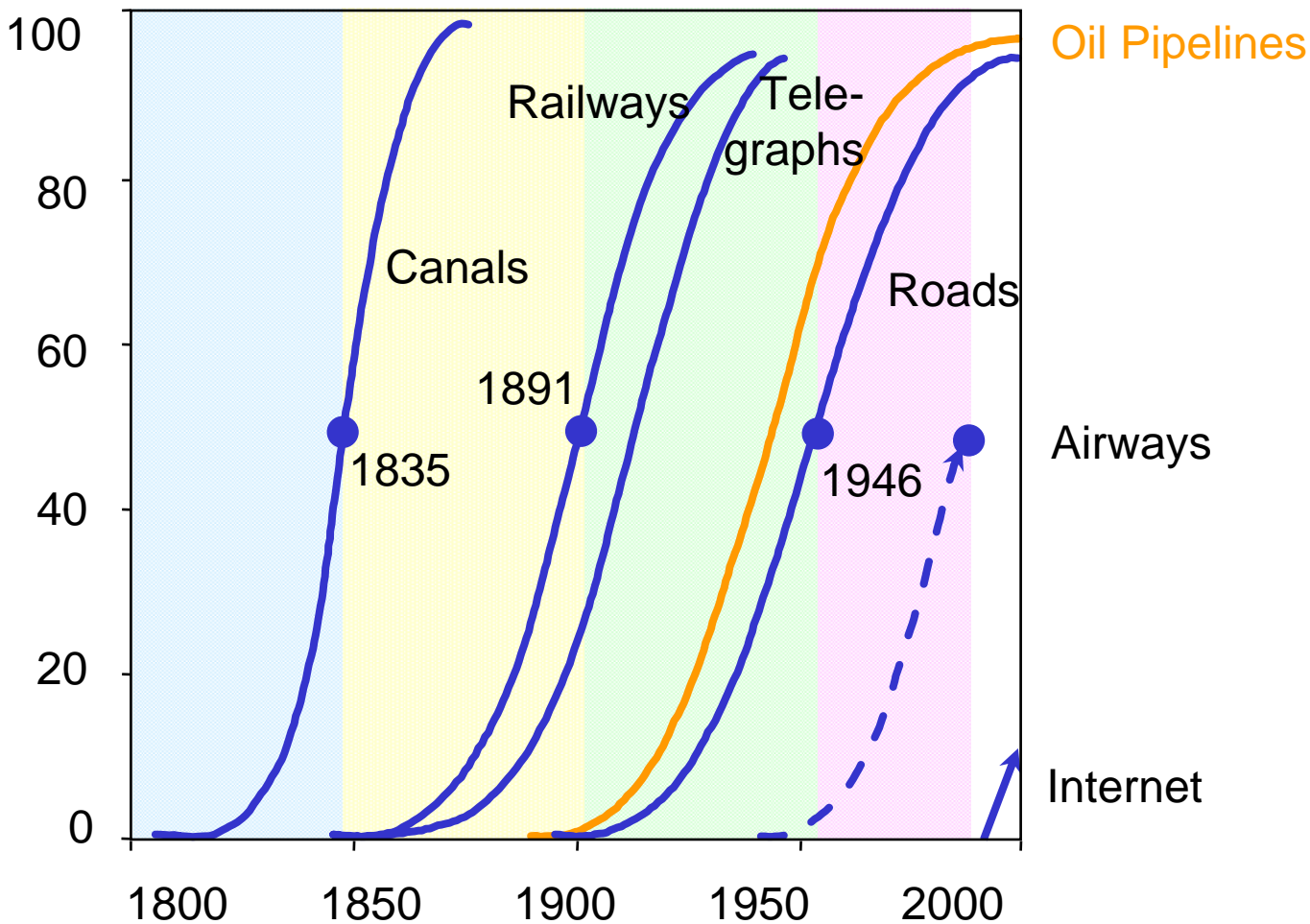
Consumer demands for more convenience, flexibility and independence, supported by advanced hydrocarbon technologies, provide an infrastructure bridge to a hydrogen economy.

Longer term this creates a large demand pull for sustainable hydrogen and renewables.



Infrastructure - The Critical Enabler

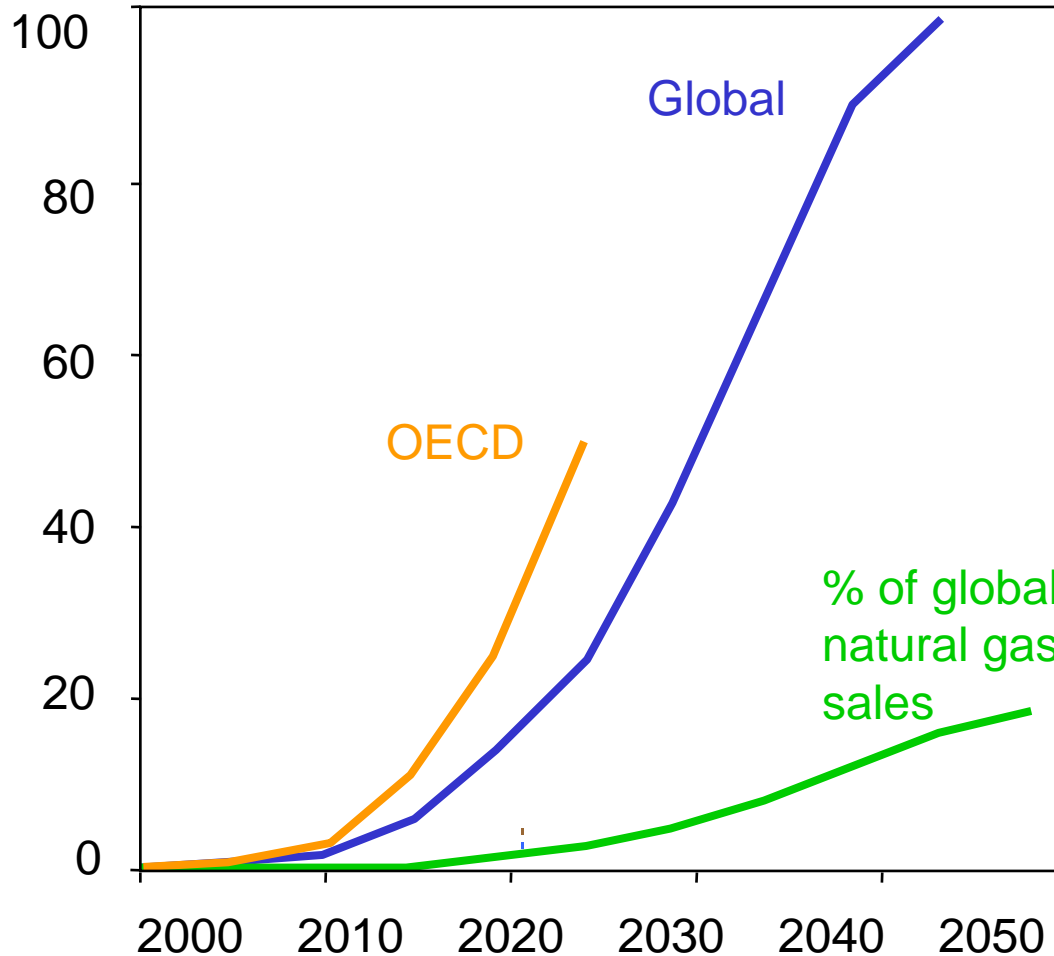
Percentage of maximum US network size





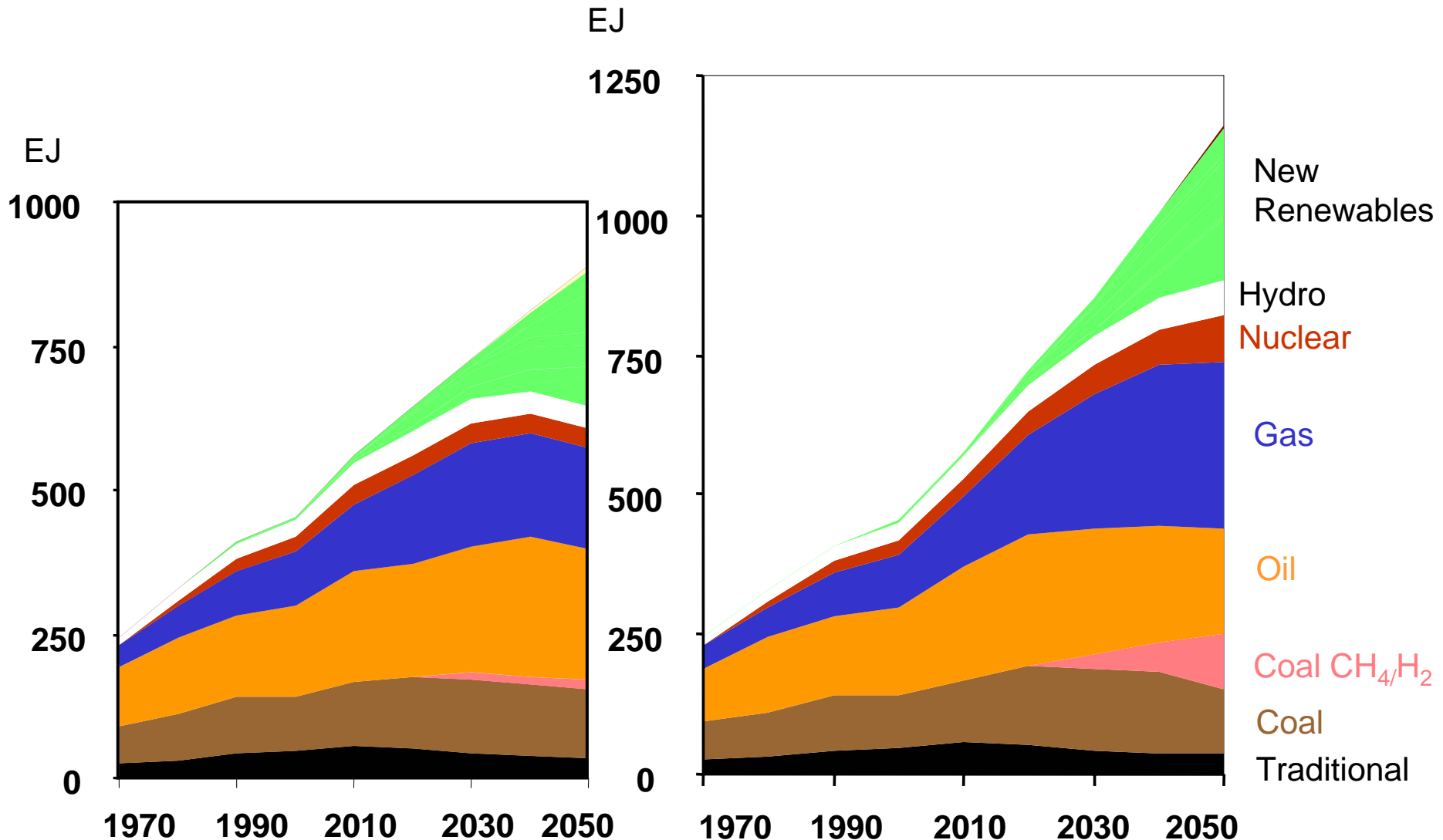
Fuel Cell Vehicle Share of Sales

% of total

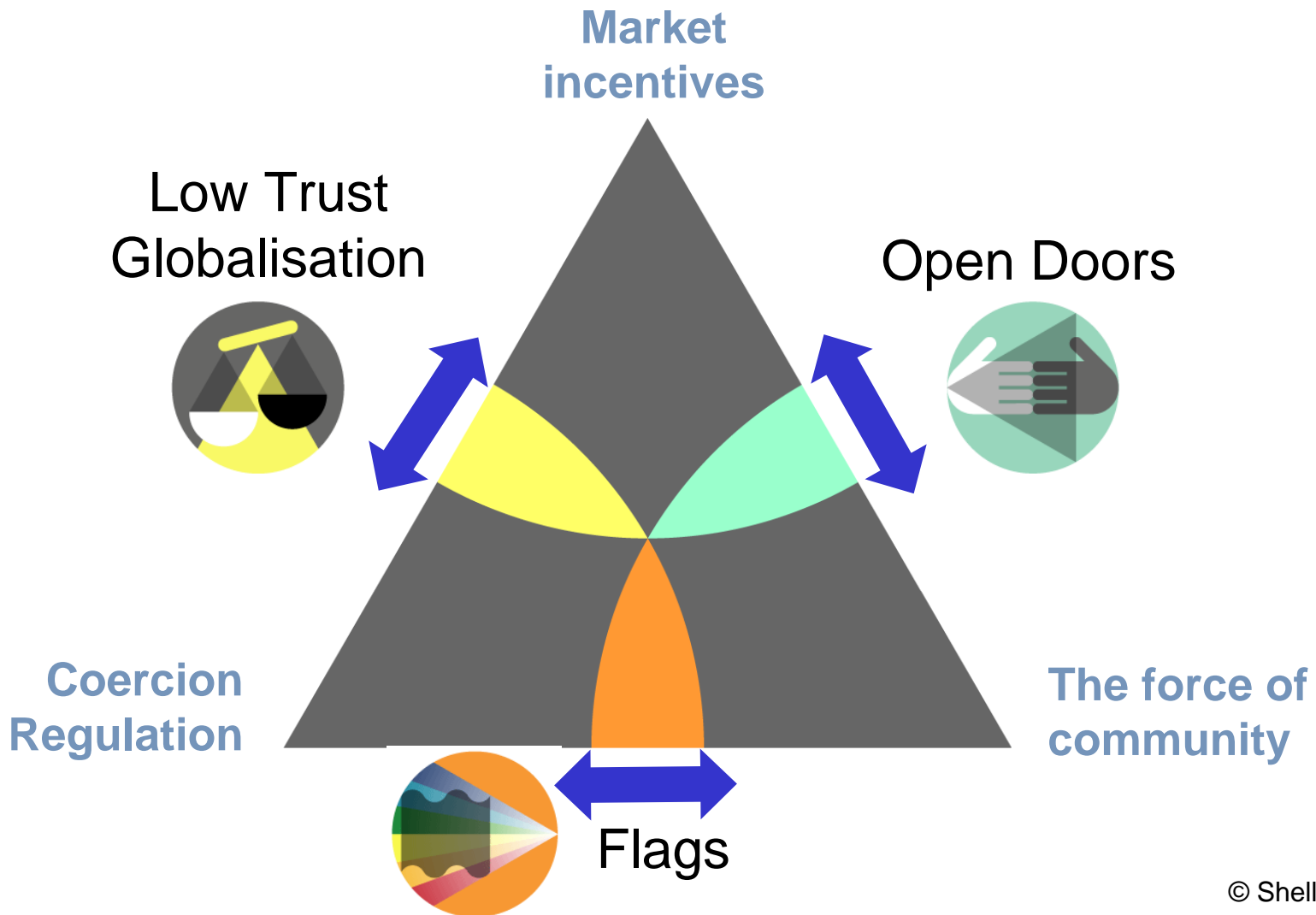


- clean, quiet
- low maintenance
- high performance
- mobile information and entertainment
- ICE cannot compete

Primary Energy Comparison



The Three Global Scenarios to 2025

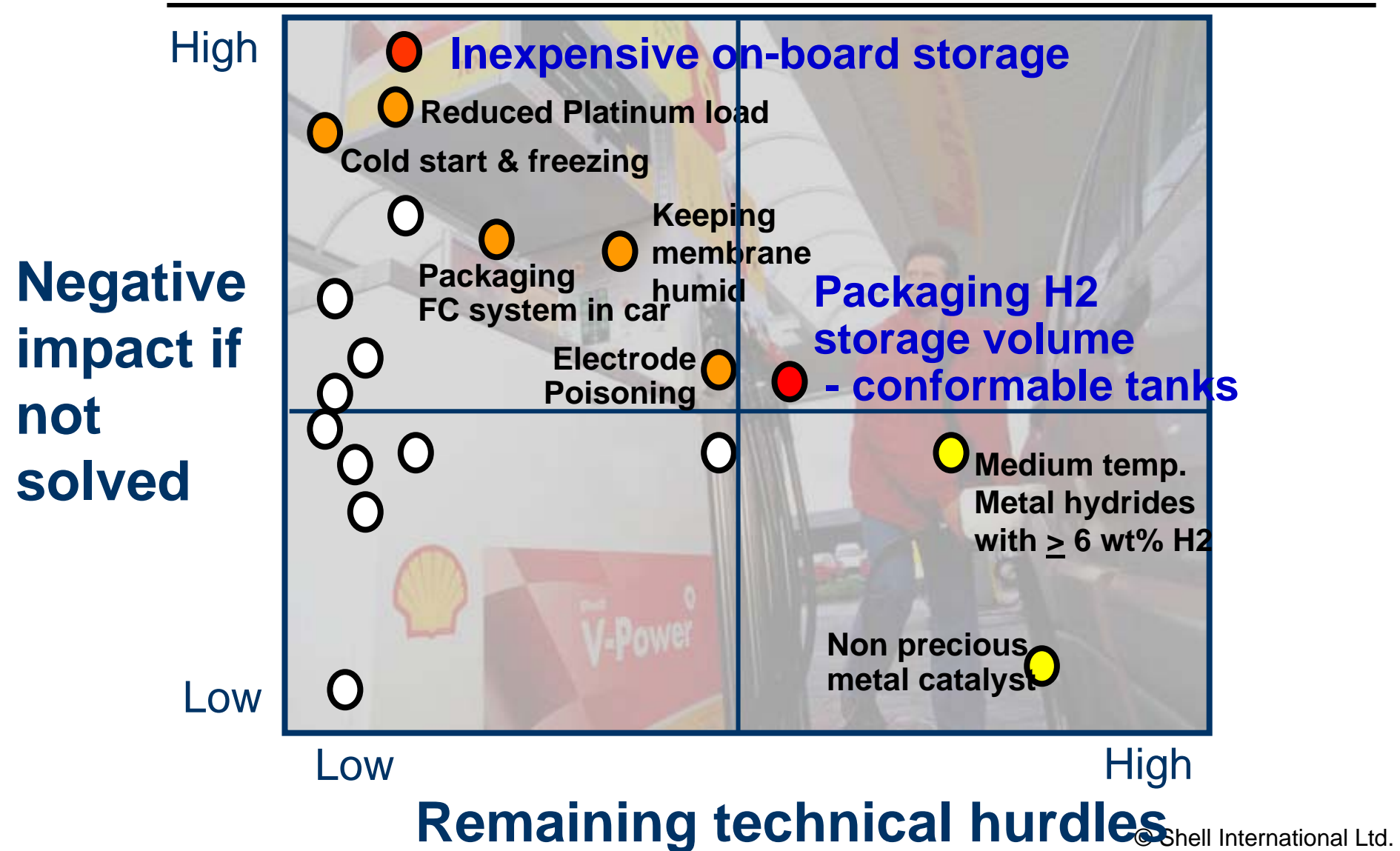


Hydrogen - Facts not fiction

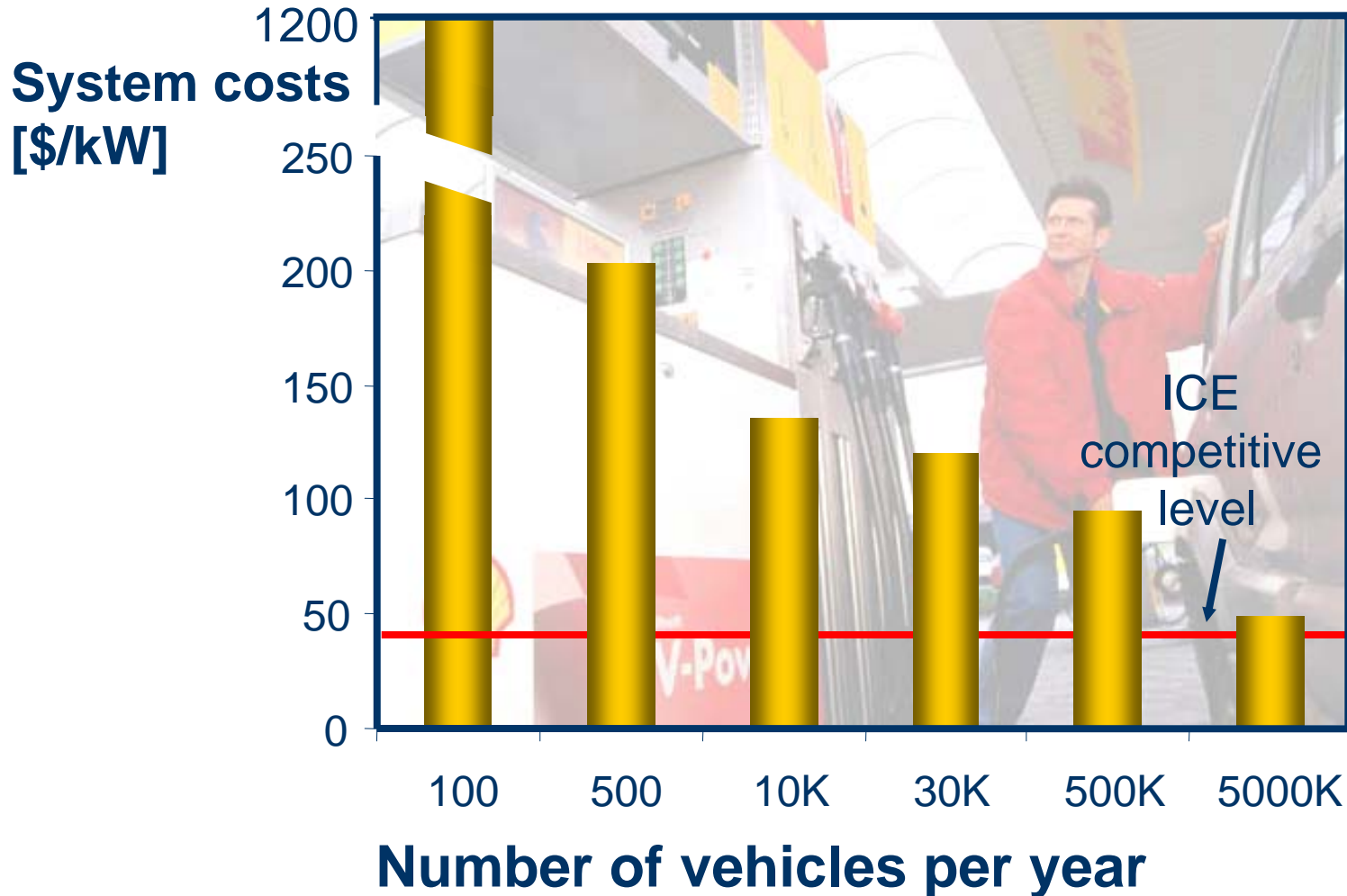
- Japan
- Iceland
- Europe
- North America



Technical issues to be addressed



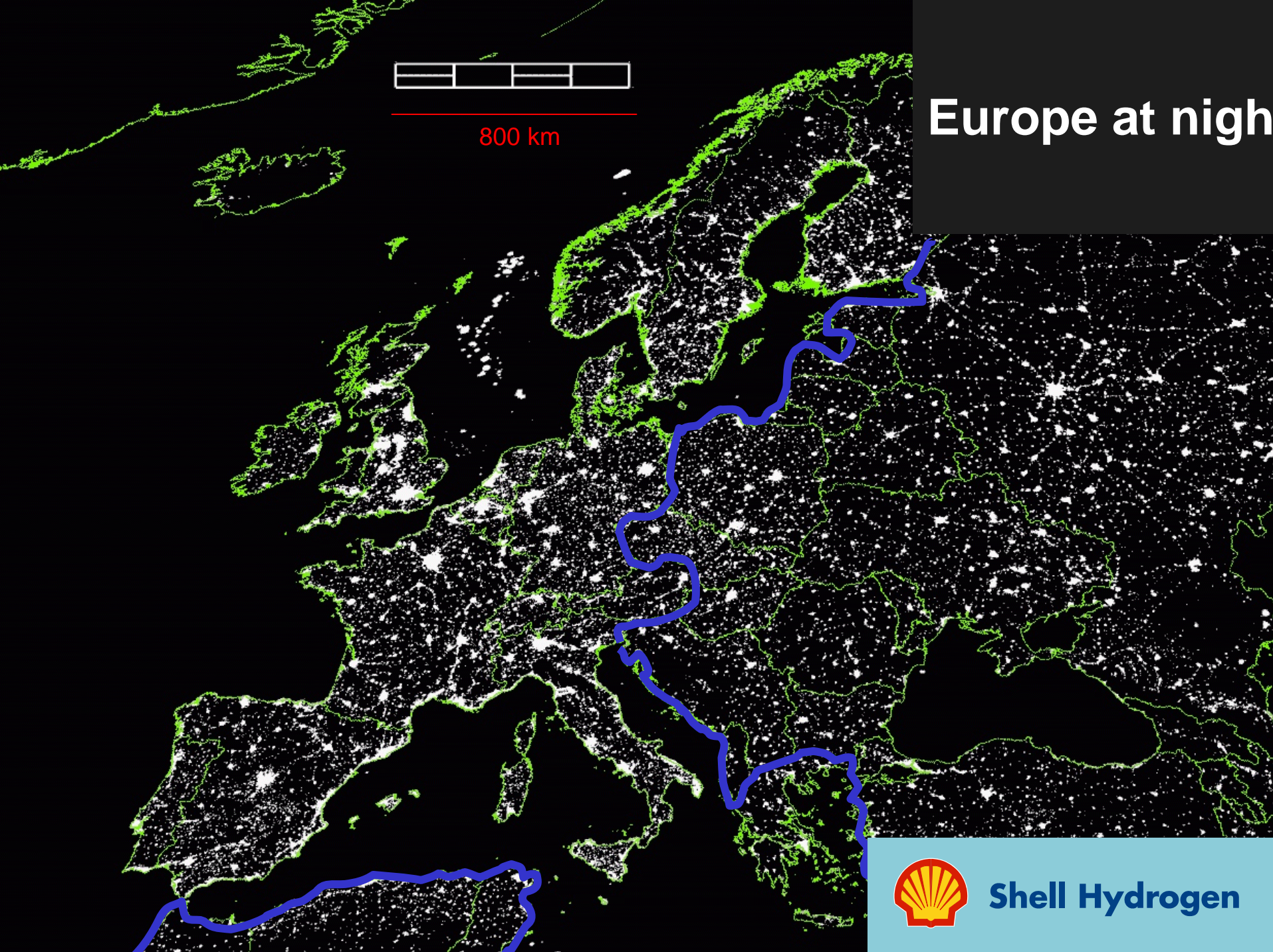
Cost of FCV drive train as function of production volume



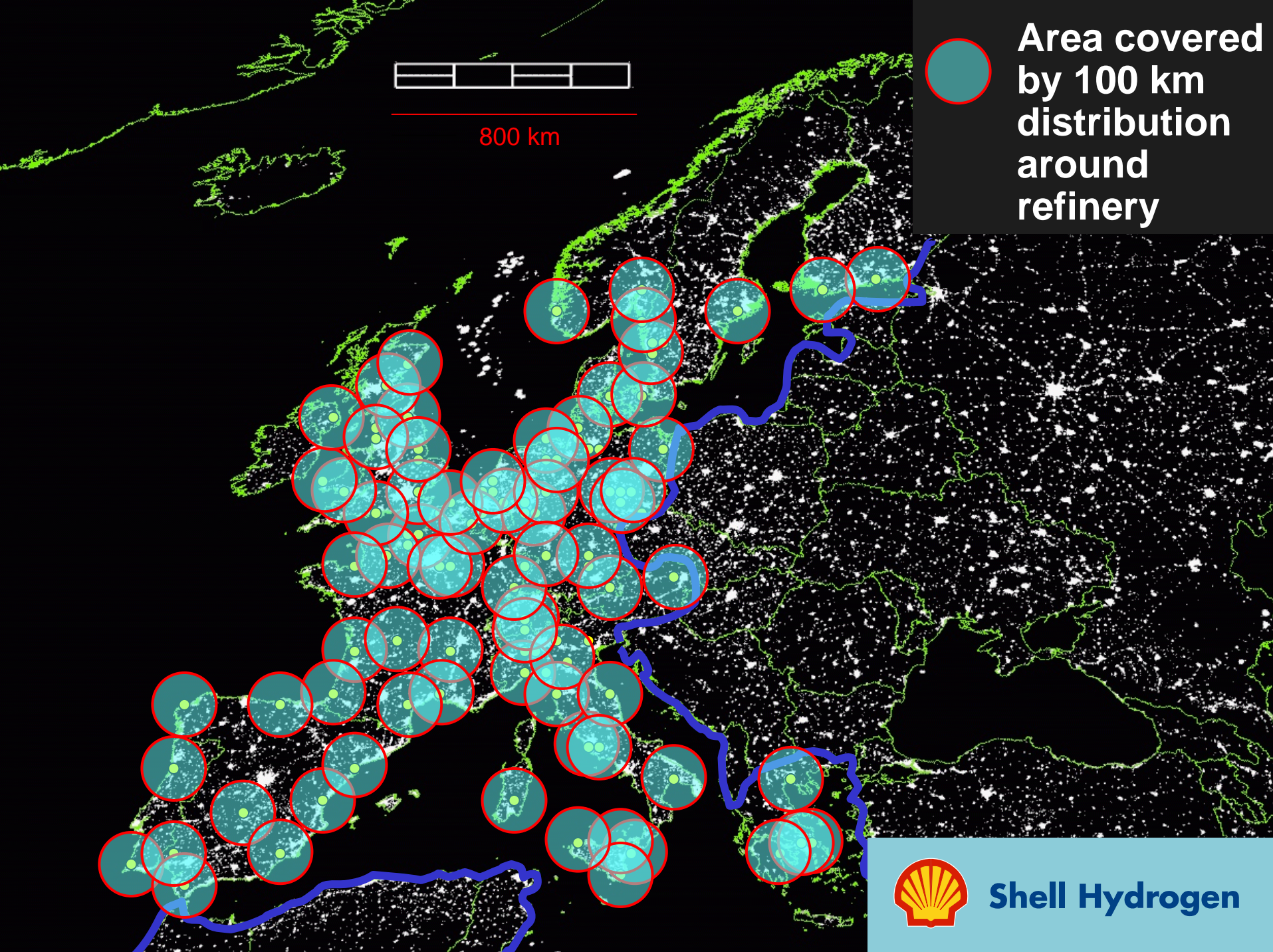
Europe at night



800 km



Shell Hydrogen



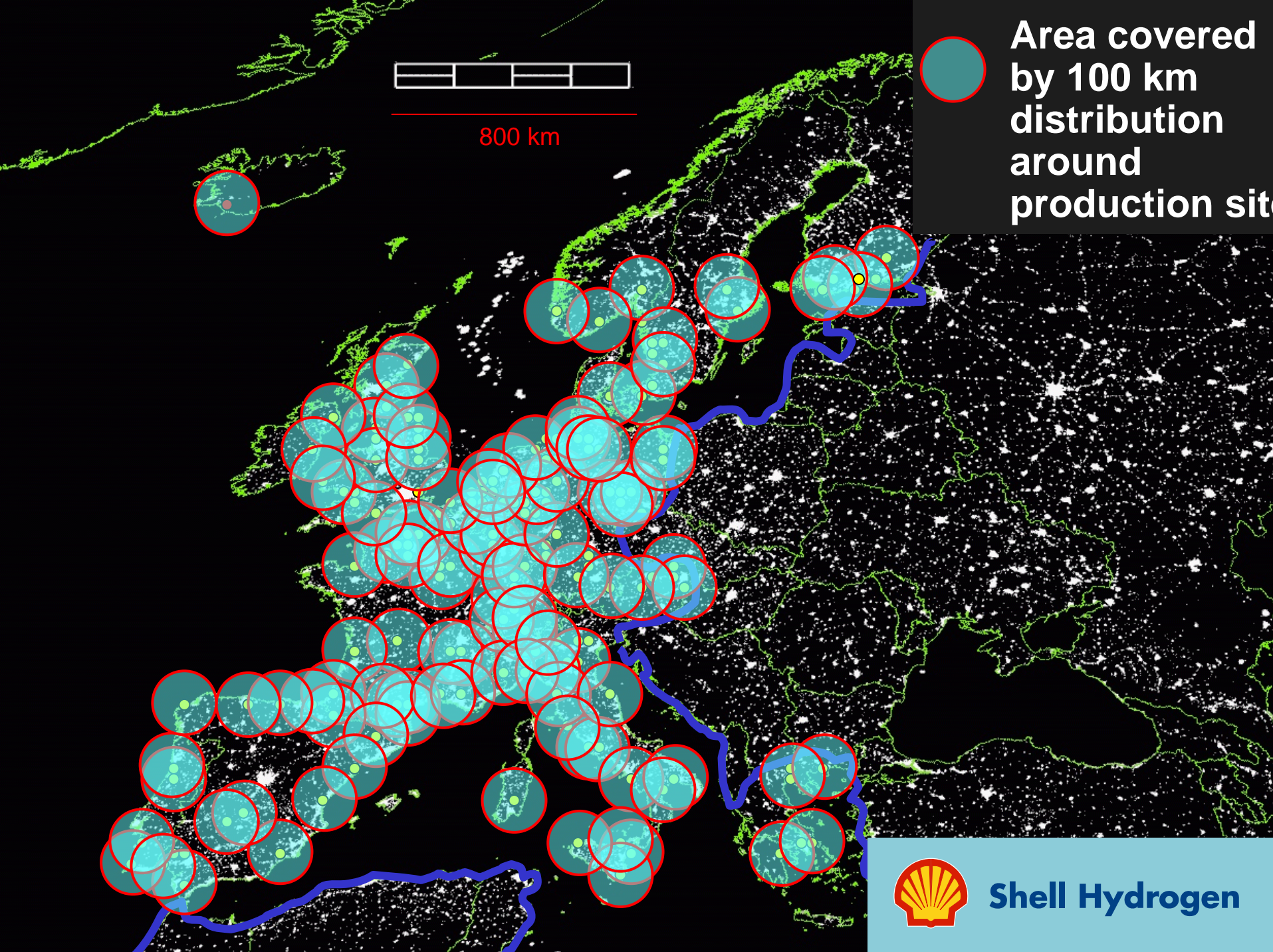
800 km



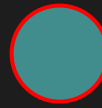
Area covered
by 100 km
distribution
around
refinery



Shell Hydrogen



800 km



Area covered
by 100 km
distribution
around
production site



Shell Hydrogen

A new approach: Mini Networks

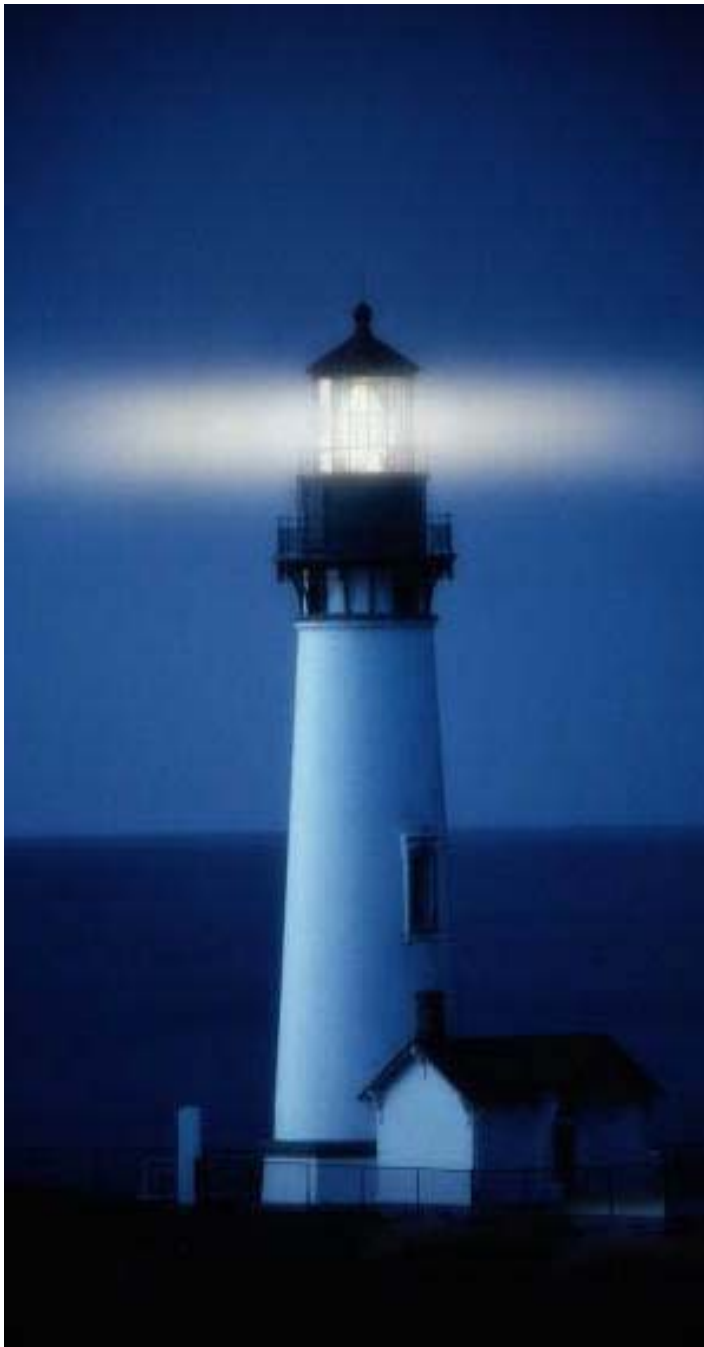


Shell Hydrogen

The next stretch: Mini Networks

- **Fleets increasing to 100 vehicles and beyond**
- **Fuelled from mini-network of 4-6 integrated hydrogen/gasoline stations**
- **Public Private Partnerships**
 - **More than one vehicle manufacturer**
 - **More than one infrastructure supplier**
 - **Fleet company**
 - **Government & regional/local authority**
- **Focus on transportation in urbanised markets**
 - **E.g. Tokyo, Los Angeles, the Rhine region**
 - **Some stationary power elements**
- **High visibility**

The Way Ahead



Lighthouse projects, with ...

- **Coordination mechanisms & incentives, that build ...**
- **Supply chain confidence, supported by ...**
- **Regulations, codes & standards, and ...**
- **Promotion of public awareness**

Substantial public-private partnerships

Where and when?

