Fuel Cells Competence-Network North Rhine Westphalia

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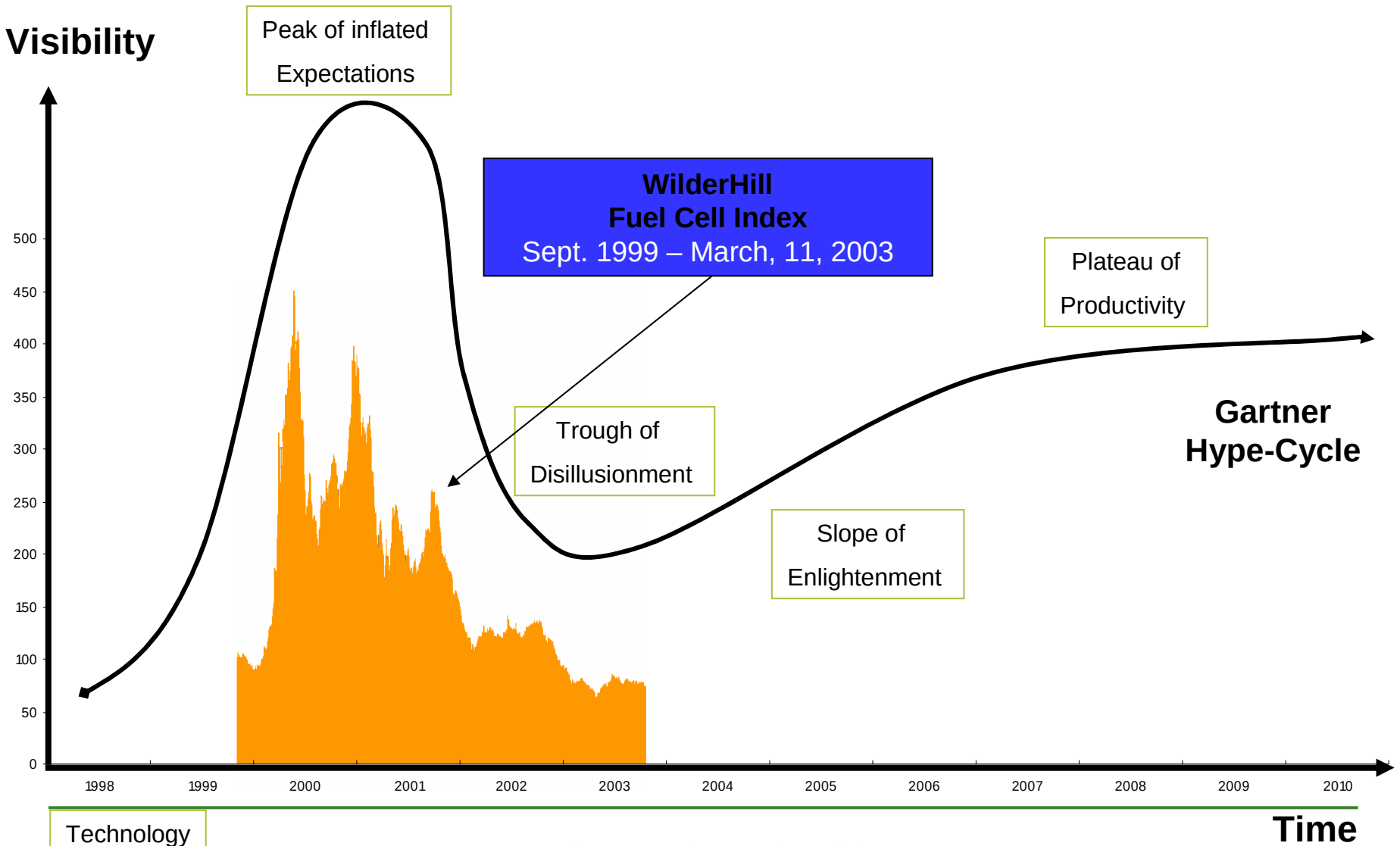
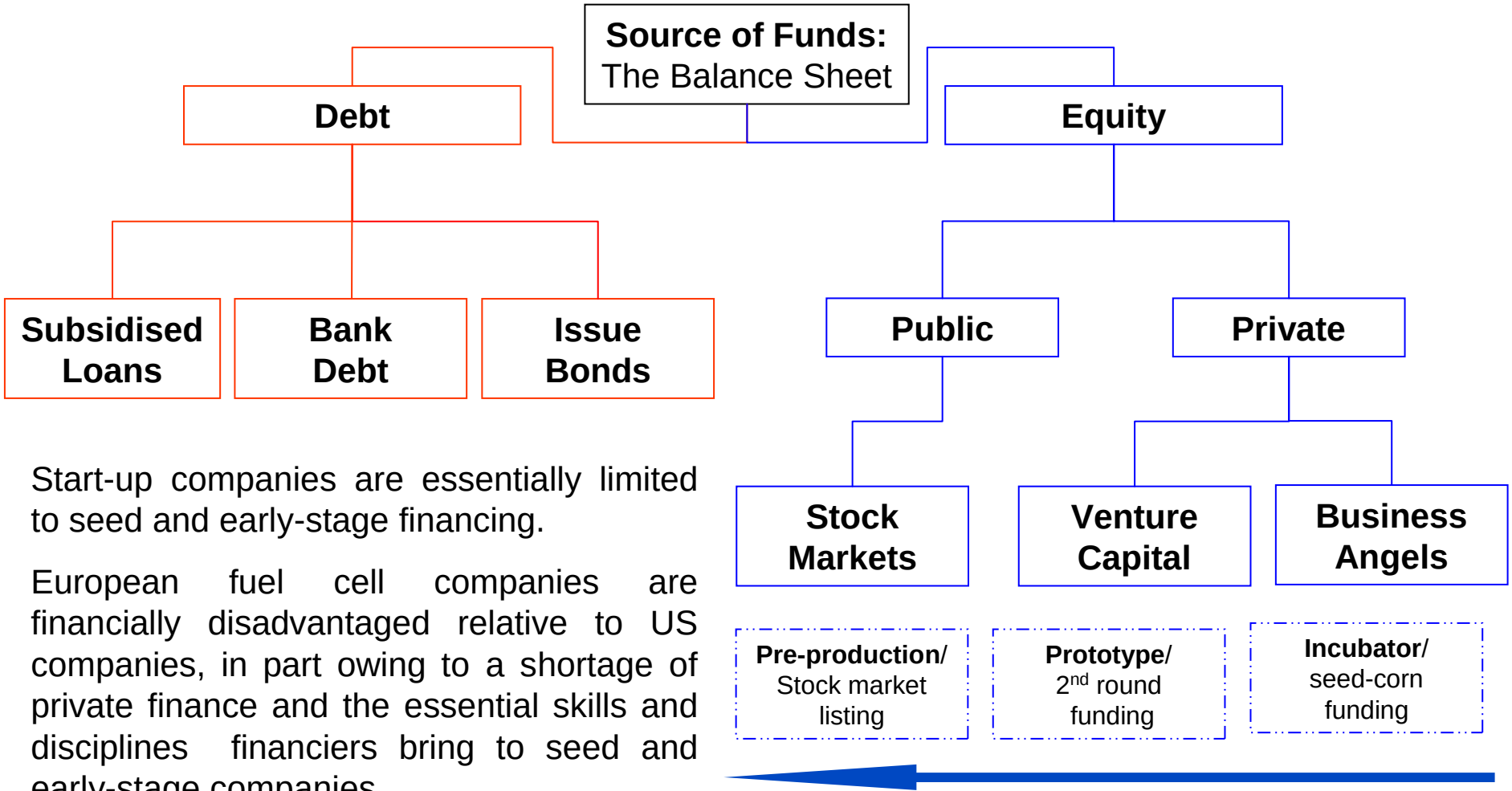
Outline

- Background:
  - Company valuations; closer to reality
  - The balance sheet and access to capital; A huge European problem
- The Supply Chain
  - Core Technology Ventures' view
  - Europe is not short of components manufacturers
  - But falls down on systems developers and access to funding
- The Structure of Europe's Non-Quoted Fuel Cell Players
  - Aggregate data
  - Electrolytes and components
- Demonstrations: Europe Germany and the US
- Finance and Policy
  - Financial & regulatory support: the US versus Europe
  - The problem of policy risk/uncertainty to investment
  - Europe's greatest potential asset: A multiplicity of policy drivers
- Conclusions

Company Valuations: Using the Gartner Hype Cycle



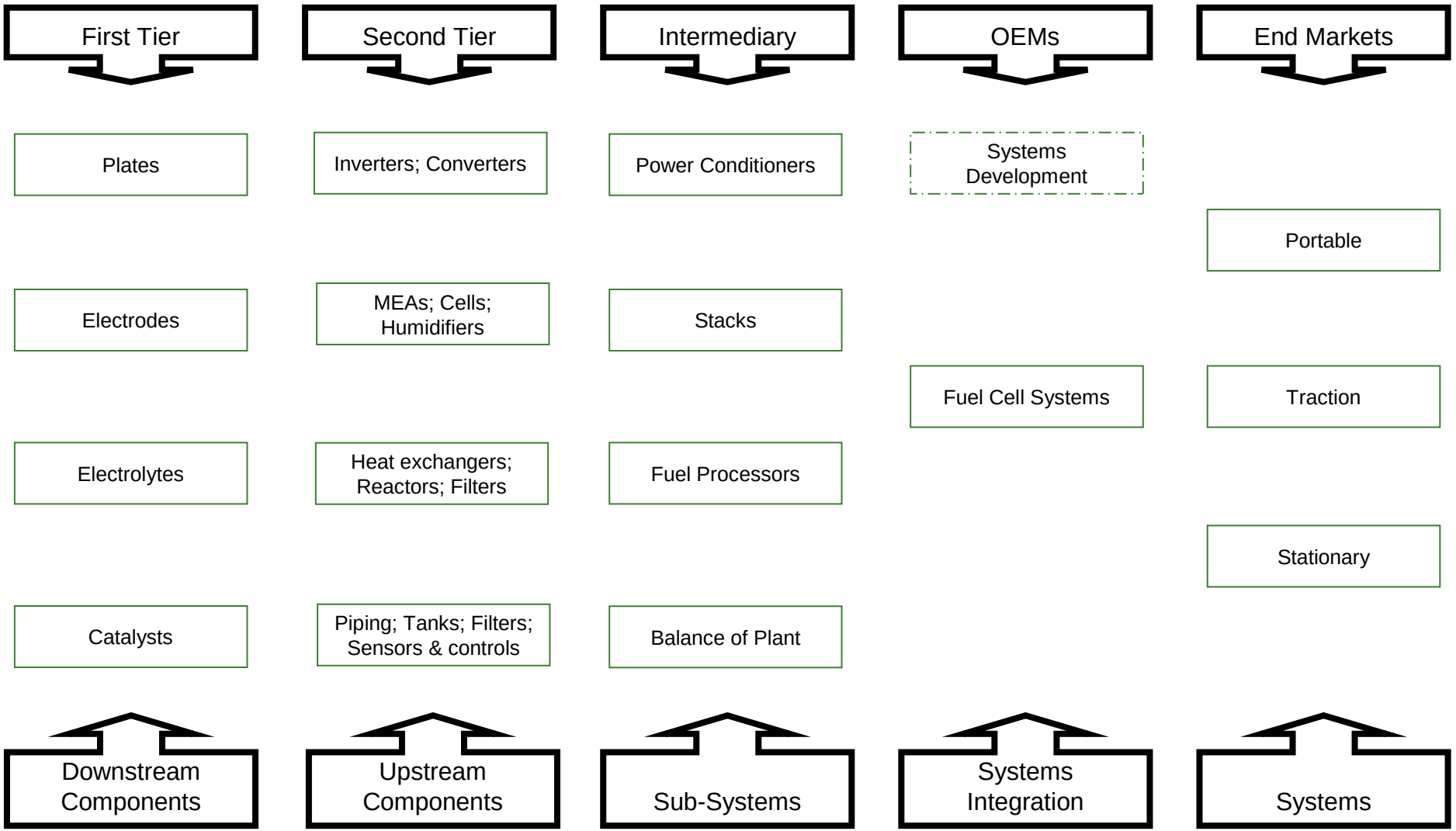
Access to Capital



Start-up companies are essentially limited to seed and early-stage financing.

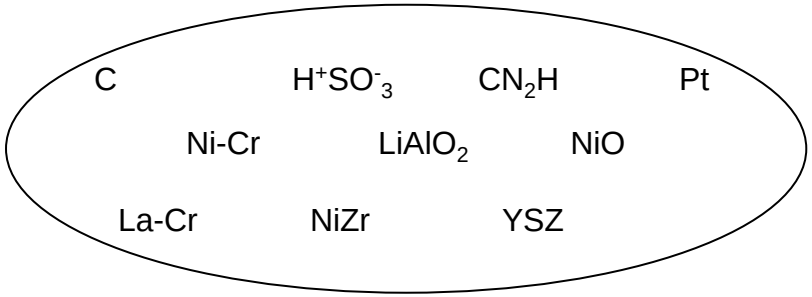
European fuel cell companies are financially disadvantaged relative to US companies, in part owing to a shortage of private finance and the essential skills and disciplines financiers bring to seed and early-stage companies.

Simplified Fuel Cell Supply Chain: Technology Risk

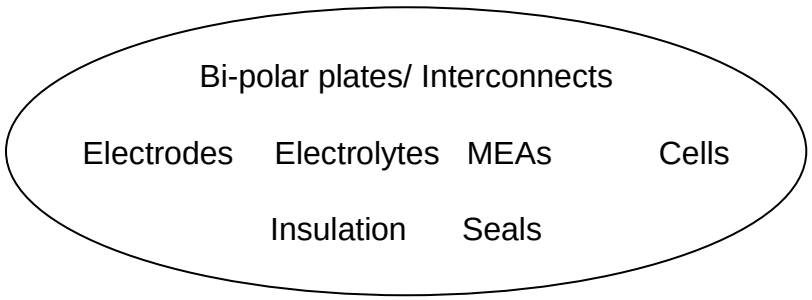


A Supply Chain: Temporal risk

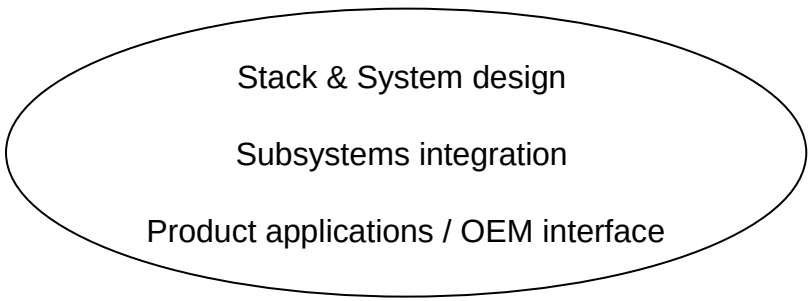
If basic materials
form the letters



And components
form the words



Then systems developers
write the text



Major Fuel Cell Components Suppliers

N America	Control	Public/ Private
Engelhard	Subsidiary	Public
E-Tek	Subsidiary	Private
GraphTech	Subsidiary.	Public
Zoltek	Subsidiary	Public
Du Pont	Subsidiary	Public
W L Gore	Subsidiary	Private

Europe	Control	Public/ Private
Advanced Ceramics Ltd	Subsidiary	Private
Freudenberg	Subsidiary	Private
Heraeus	Subsidiary	Private
HT Ceramix	Core	Private
Schunk	Subsidiary	Private
Unitec Ceramics	Subsidiary	Public
Johnson Mat.	Subsidiary	Public
Morgan FC.	Subsidiary	Public
Porvair	Subsidiary	Public
SGL Carbon	Subsidiary	Public
Süd Chemie	Subsidiary	Public
UCM	Subsidiary.	Public
FumaTech	Subsidiary	Public
Solvay	Subsidiary	Public
Ticona	Subsidiary	Public
Vitrex	Subsidiary	Public

Europe is not short of suppliers, but …

Key:

Materials Specialists

Membrane Specialists

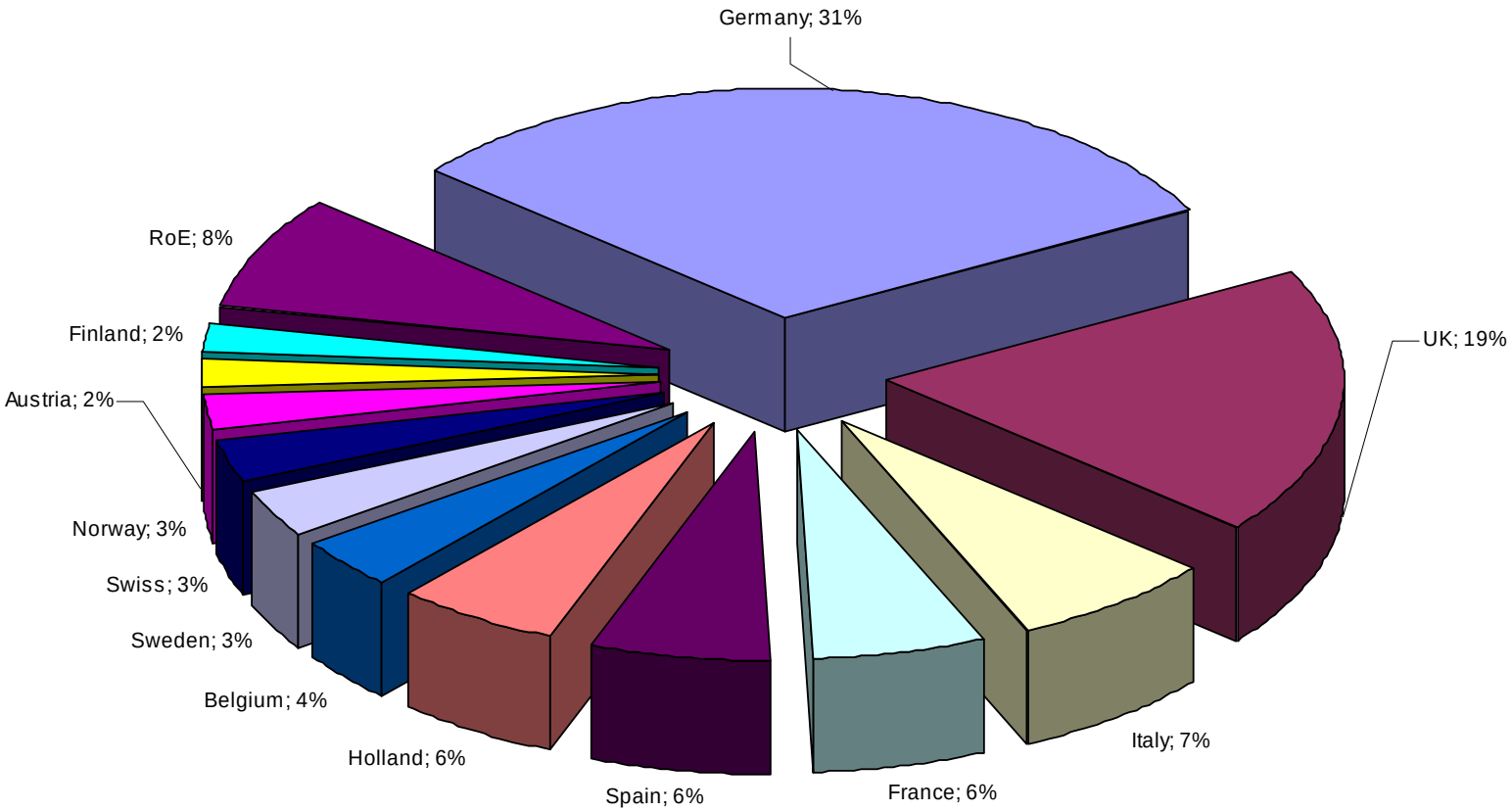
Independent Fuel Cell Systems Developers

North America.	Owner	Market Cap. ($m)*
Acumentrics	Private	n.a.
Astris Energi Inc	Public	n.a
Ballard Power	Public	1,581
ECD	Public	223
Energy Visions	Public	3
Fuel Cell Energy	Public	340
Global Thermo	Public	78
Hydrogenics	Public	213
Millennium Cell	Public	54
Nuvera	Private	n.a.
Plug Power	Public	286
Proton Energy	Public	77
Market Capitalisation		$2,855

Europe	Owner	Market Cap.
H-Tec	Private	0
Helion	Govt.	0
Intelligent Energy	Private	0
Nedstack	Private	0
Proton Motor	Private	0
P21	Private	0
Market Capitalisation		ZERO

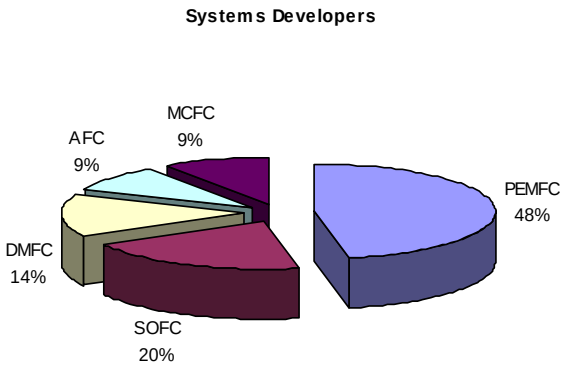
… is light on developers, and with no quoted sector is financially disadvantaged

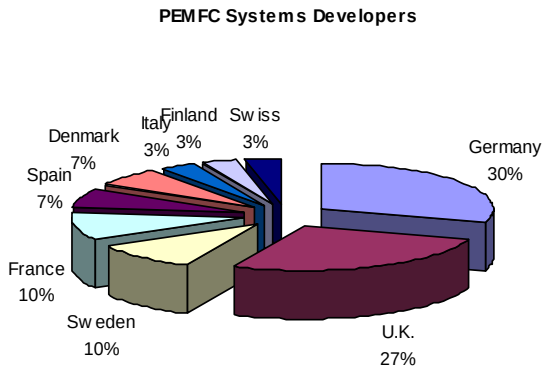
Distribution of the European Fuel Cell Industry: Sample data

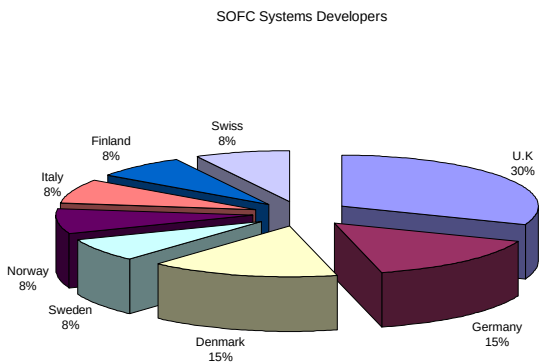


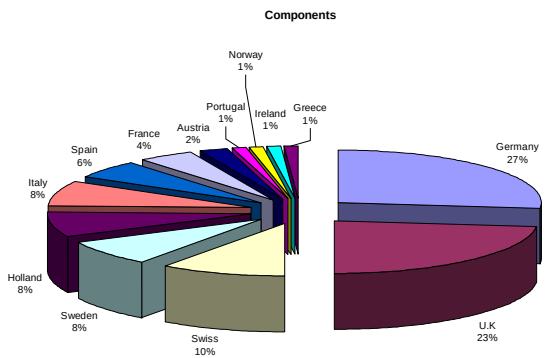
*Source: Core Technology Ventures LLP. Data, a subset of our database, refer to number of European entities developing fuel cell related hardware but excludes well-capitalised & quoted companies

European Systems and Components: sample data



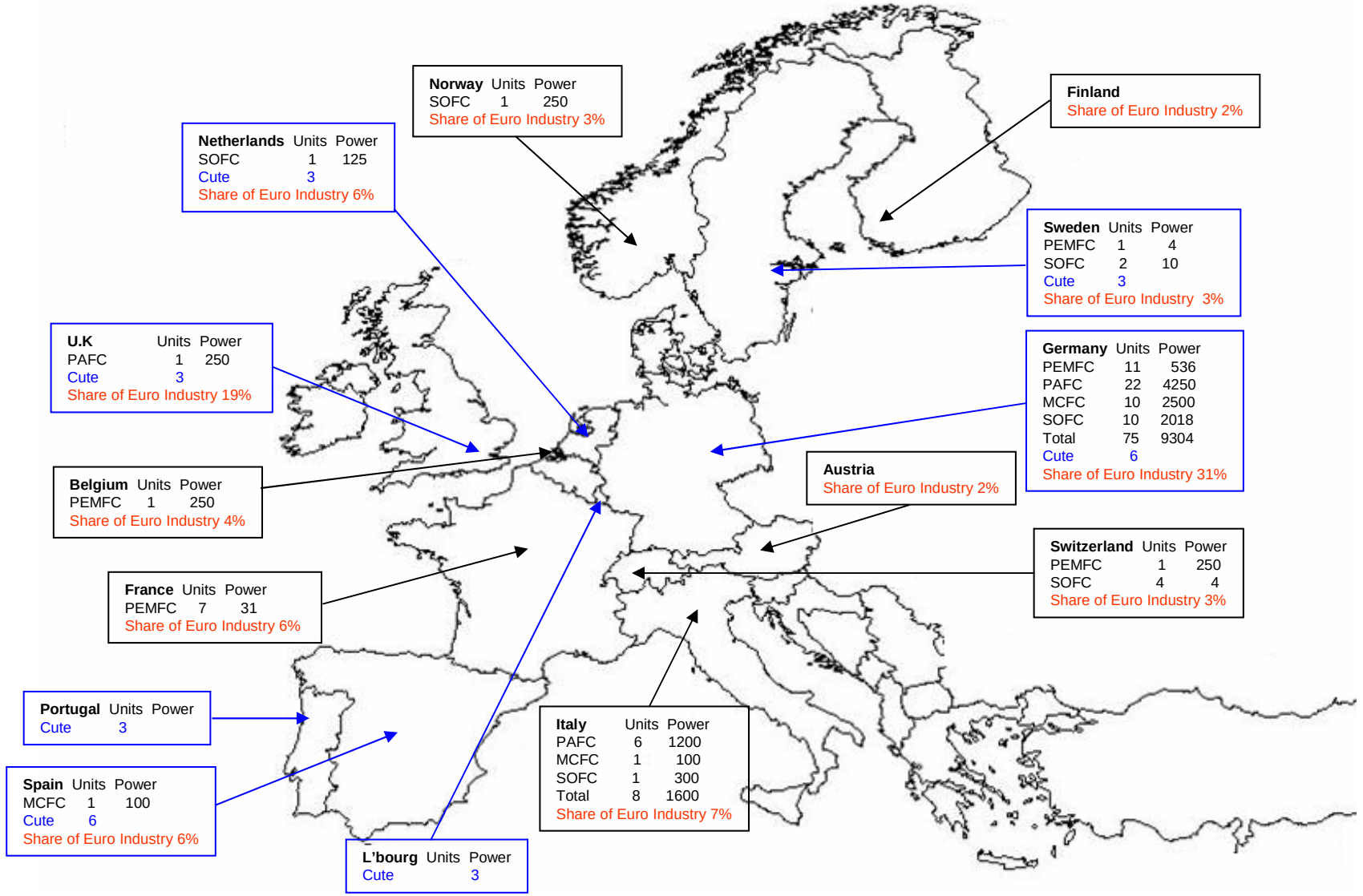






*Source: Core Technology Ventures LLP. Data, a subset of our database, refer to number of European entities developing fuel cell related hardware but excludes well-capitalised & quoted companies

European Map: 12MW Stationary, 27 Buses



Note: Stationary data refer to plant installed over the last 10 years and planned over the next 18 months

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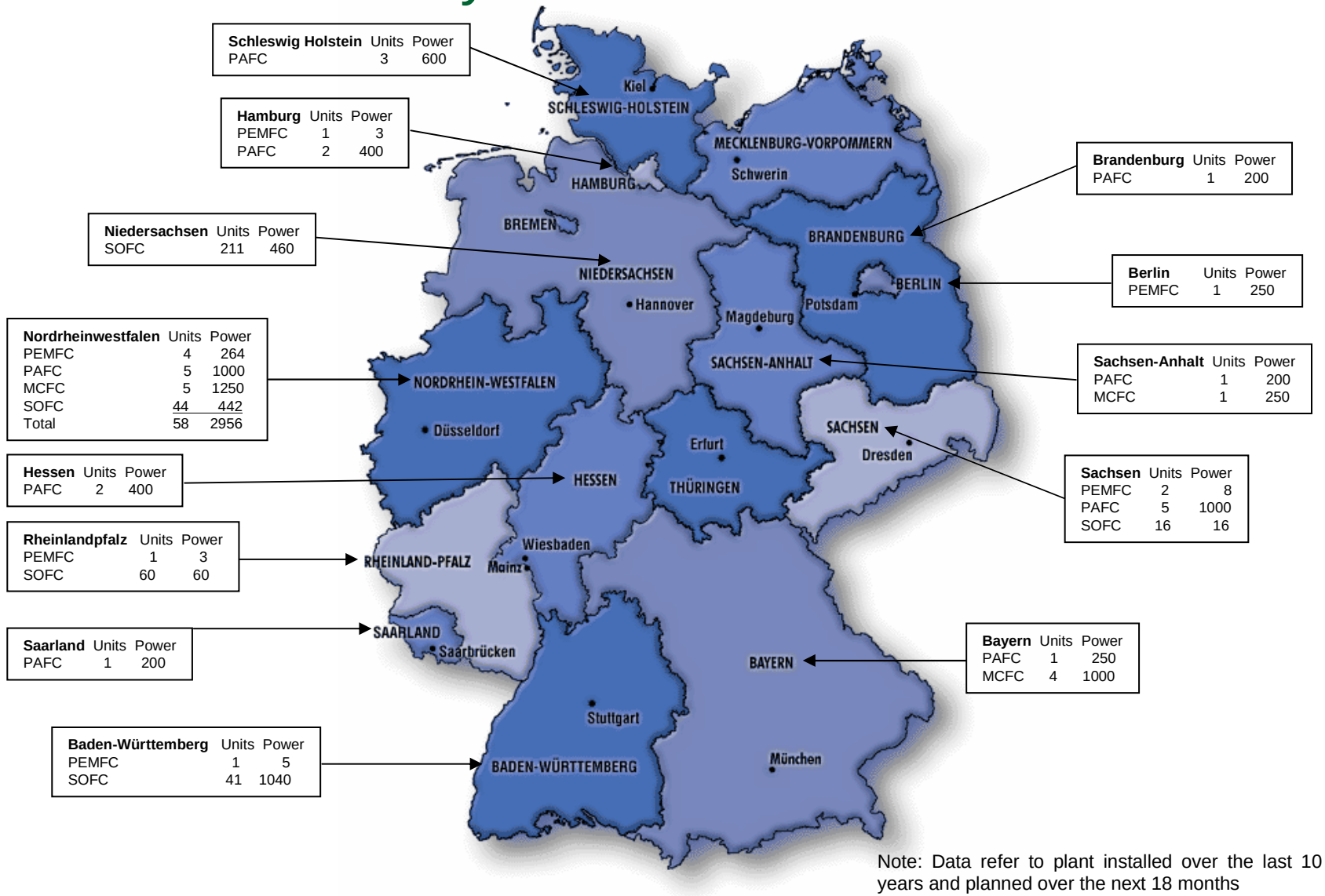
Source: Share of EU Industry Core Technology Ventures LLP

See slide 9 above

German Stationary Fuel Cell Demonstrations:



Schleswig Holstein	Units	Power
PAFC	3	600

Hamburg	Units	Power
PEMFC	1	3
PAFC	2	400

Niedersachsen	Units	Power
SOFC	211	460

Nordrheinwestfalen	Units	Power
PEMFC	4	264
PAFC	5	1000
MCFC	5	1250
SOFC	44	442
Total	58	2956

Hessen	Units	Power
PAFC	2	400

Rheinlandpfalz	Units	Power
PEMFC	1	3
SOFC	60	60

Saarland	Units	Power
PAFC	1	200

Baden-Württemberg	Units	Power
PEMFC	1	5
SOFC	41	1040

Brandenburg	Units	Power
PAFC	1	200

Berlin	Units	Power
PEMFC	1	250

Sachsen-Anhalt	Units	Power
PAFC	1	200
MCFC	1	250

Sachsen	Units	Power
PEMFC	2	8
PAFC	5	1000
SOFC	16	16

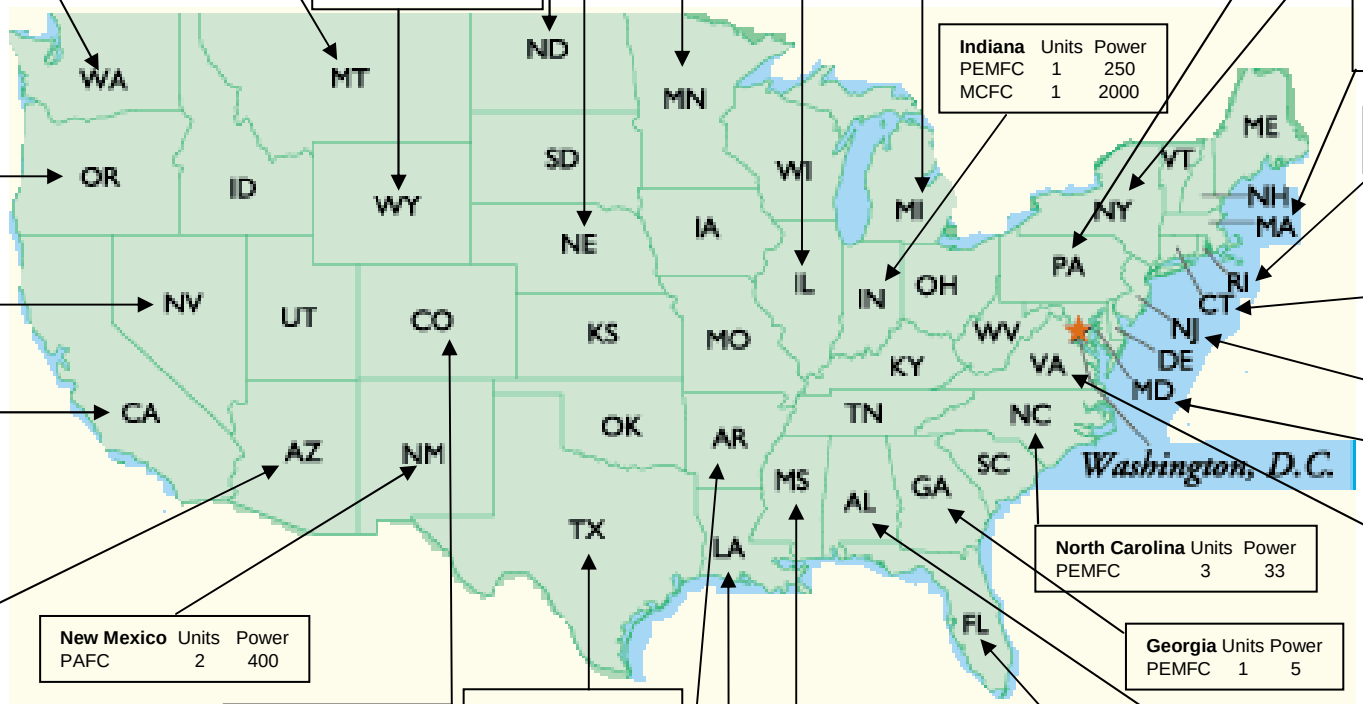
Bayern	Units	Power
PAFC	1	250
MCFC	4	1000

Note: Data refer to plant installed over the last 10 years and planned over the next 18 months

German Total 9.3MW

NRW Total: 3MW

US Fuel Cell Demonstrations: 40MW Stationary



Alaska	Units	Power
PAFC	8	1600
SOFC	1	250

Unknown Locations	Units	Power
PEMFC	157	558
PAFC	17	3400
MCFC	1	250

Oregon	Units	Power
PEMFC	3	15
PAFC	1	200

Nevada	Units	Power
PAFC	2	400

California	Units	Power
PEMFC	26	98
PAFC	20	4000
MCFC	5	3000
SOFC	6	245
Total	57	7343

Arizona	Units	Power
PAFC	2	400

Hawaii	Units	Power
PEMFC	1	5

Washington	Units	Power
PEMFC	2	8
PAFC	1	200
MCFC	1	1000

Montana	Units	Power
PEMFC	1	5

Wyoming	Units	Power
PEMFC	1	4.5

North Dakota	Units	Power
PAFC	1	200

Nebraska	Units	Power
PAFC	6	1200

Minnesota	Units	Power
PAFC	2	400

Illinois	Units	Power
PEMFC	1	3
PAFC	1	200

Michigan	Units	Power
PEMFC	2	10
PAFC	3	600

Indiana	Units	Power
PEMFC	1	250
MCFC	1	2000

Pennsylvania	Units	Power
PEMFC	2	1.25
PAFC	6	1200

New York	Units	Power
PEMFC	229	1815
PAFC	32	6400
MCFC	2	500
Total	263	8751

Massachusetts	Units	Power
PEMFC	5	1000
MCFC	1	250

Rhode Island	Units	Power
PAFC	2	400

Connecticut	Units	Power
PAFC	15	3000
MCFC	1	250
SOFC	1	25
Total	17	3275

New Jersey	Units	Power
PAFC	4	800
MCFC	2	500

Maryland	Units	Power
PEMFC	2	9
MCFC	1	200

Virginia	Units	Power
PAFC	2	400
MCFC	1	200

North Carolina	Units	Power
PEMFC	3	33

Georgia	Units	Power
PEMFC	1	5

Alabama	Units	Power
MCFC	1	250

Florida	Units	Power
AFC	1	10
PAFC	1	200

Louisiana	Units	Power
PEMFC	1	5
PAFC	1	200

Arkansas	Units	Power
PAFC	2	400

Mississippi	Units	Power
PAFC	1	200

TEXAS	Units	Power
PEMFC	3	9
PAFC	4	800

Colorado	Units	Power
PEMFC	2	10

New Mexico	Units	Power
PAFC	2	400

Note: Data refer to plant installed over the last 10 years and planned over the next 18 months

Financial & Regulatory Support: US versus Europe

	North America	Europe
Venture Capital Initiative	Yes	No
Private Financing (V.C.s)	Yes	Minimal
Public Finance (e.g. NASDAQ)	Yes	No
State Financing	$210m	€ 120m
Per Capita State Financing	$0.81c	€ 0.38c
Public Procurement Policies	Yes	No
Fuel Cell Military Contracts	Yes	??
Specific Regulations (e.g. ZEV)	Yes	No

Europe's FC industry is struggling for cash and financial expertise
Europe's investment community is missing regulatory support:

*The US 'Venture Capital Initiative' is a $25m fund set up by the Dept of Defence to invest in portable power

Sources:

US, Fuel Cells 2000, DoE

Europe: FW5 + member states' matching funds (est.)

Policy versus Regulation: A source of risk!

- Governments provide
  - The Policy Framework and
  - The Legal & Regulatory Framework, which may hinder an emerging technology. The UK New Trading Arrangements are a case in point.
  - Financial markets take account of the legal & regulatory framework within which policy is executed, NOT the policy in isolation

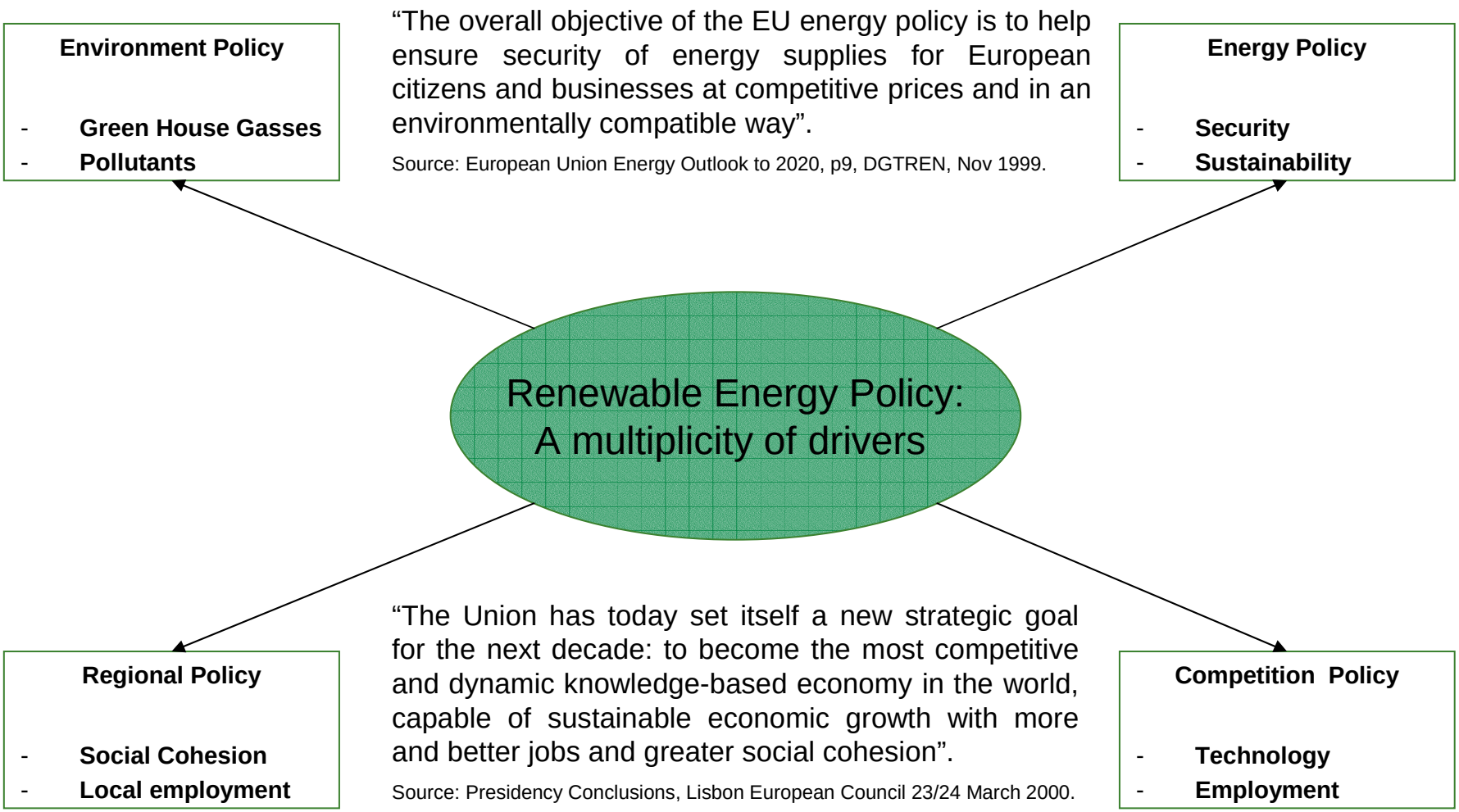
- The authorities may not always realise the importance of policy credibility, a necessary condition to attract the indispensable private financing

- On the basis of current regulatory, financial & fiscal support for fuel cells
  - The US and Japanese appear to be streets ahead of the Europeans.
  - On present trends the danger is the US will build on its fiscal, regulatory and financial market advantage and suck ever greater quantities of capital out of Europe. Manufacturing capacity and human capital (jobs) will follow financial capital.
  - As far as the High-Level Group for Hydrogen and Fuel Cells, we reserve judgement

- But Europe and the EU could build on its renewables strategy
  - by extending this vision to fuel cells and ensuring entrenched industries do not abuse the regulatory process

- We believe that it is a matter of time before the link between renewable sources and fuel cells is made, and if it is the policy drivers multiply

European Policy Drivers: Resolving paradoxes



Conclusions

- The European fuel cell industry displays relative weakness when compared to the US namely:
  - Access to private capital and the associated financial and commercial expertise is lacking
  - State funding levels remain significantly below major competitors
  - European demonstrations need to be addressed
  - Government support varies significantly across a fragmented Union: Germany leads
- On the positive side, Europe possesses a significant number of players, particularly in materials and components which should ultimately attract private finance
- From our perspective fuel cells are a natural complement to renewable energy sources
  - European policy has created the largest wind industry in the world.
  - The next logical step would be to extend this vision to incorporate fuel cells
  - Such political commitment would in part overcome the inherent financial disadvantages facing early-stage companies
  - But ultimately the industry must deliver
- From a financial perspective the potential size of the fuel cell industry is massive
- From a political perspective this implies huge investment requirements and corresponding job opportunities
- From an industry perspective it is time to speak with a single voice, avoid internal arguments and unite under a single European Fuel Cells Association:
  - Fuel Cells Europe has begun the process