



CORE TECHNOLOGY VENTURES SERVICES

Building on Breakthroughs in Polymer Fuel Cells Workshop

The Carbon Trust:
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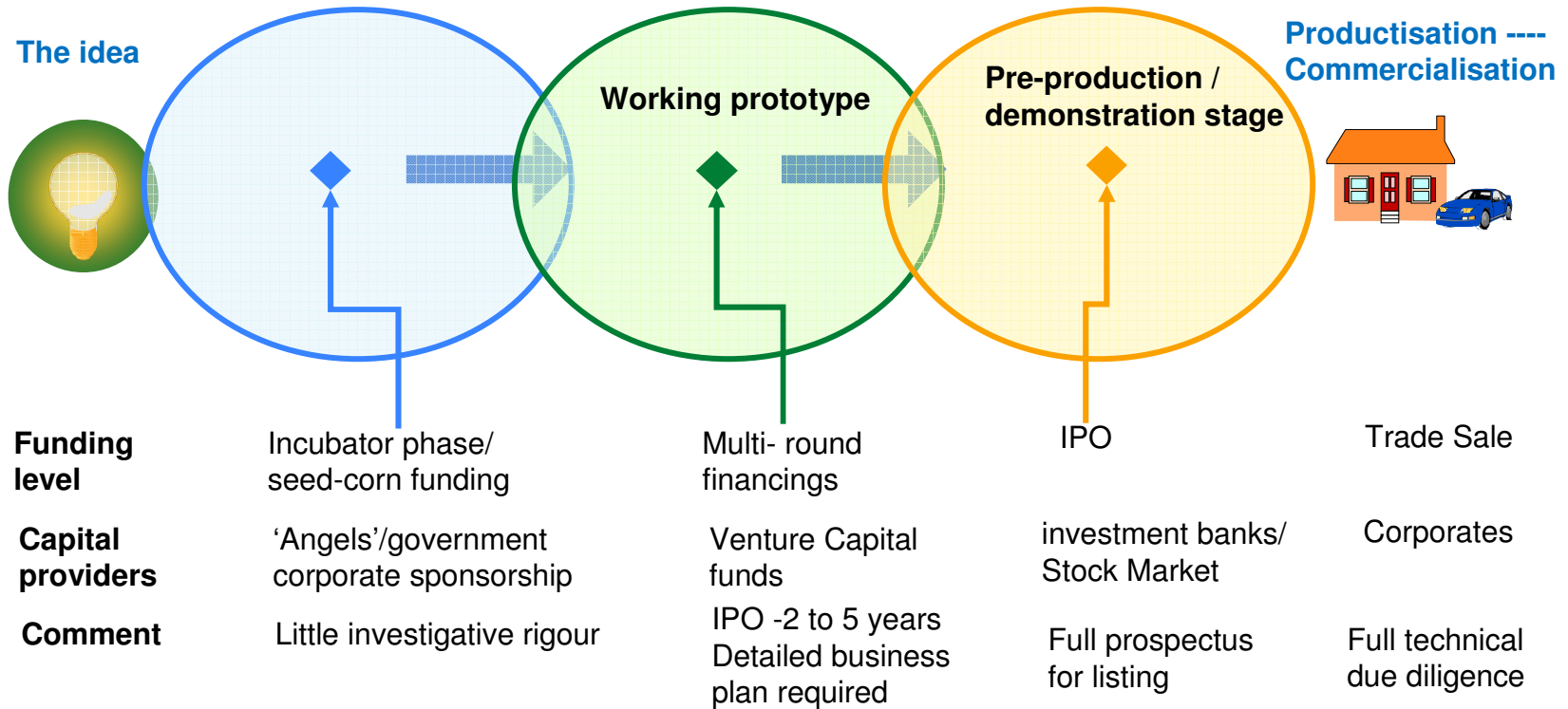


Agenda

1. Independent Developers' Journey : Technical Risk and Equity
2. Fuel Cell Chains: Multi-Industry
3. PEM Players: Global Industry
4. European H2&FC Industry: Dominated by Independents and Academics
5. Stages of Risk
6. The Significance of Germany
7. The Significance of North Rhine Westphalia
8. Concluding Remarks



Independent Developers Initially dependent on Equity

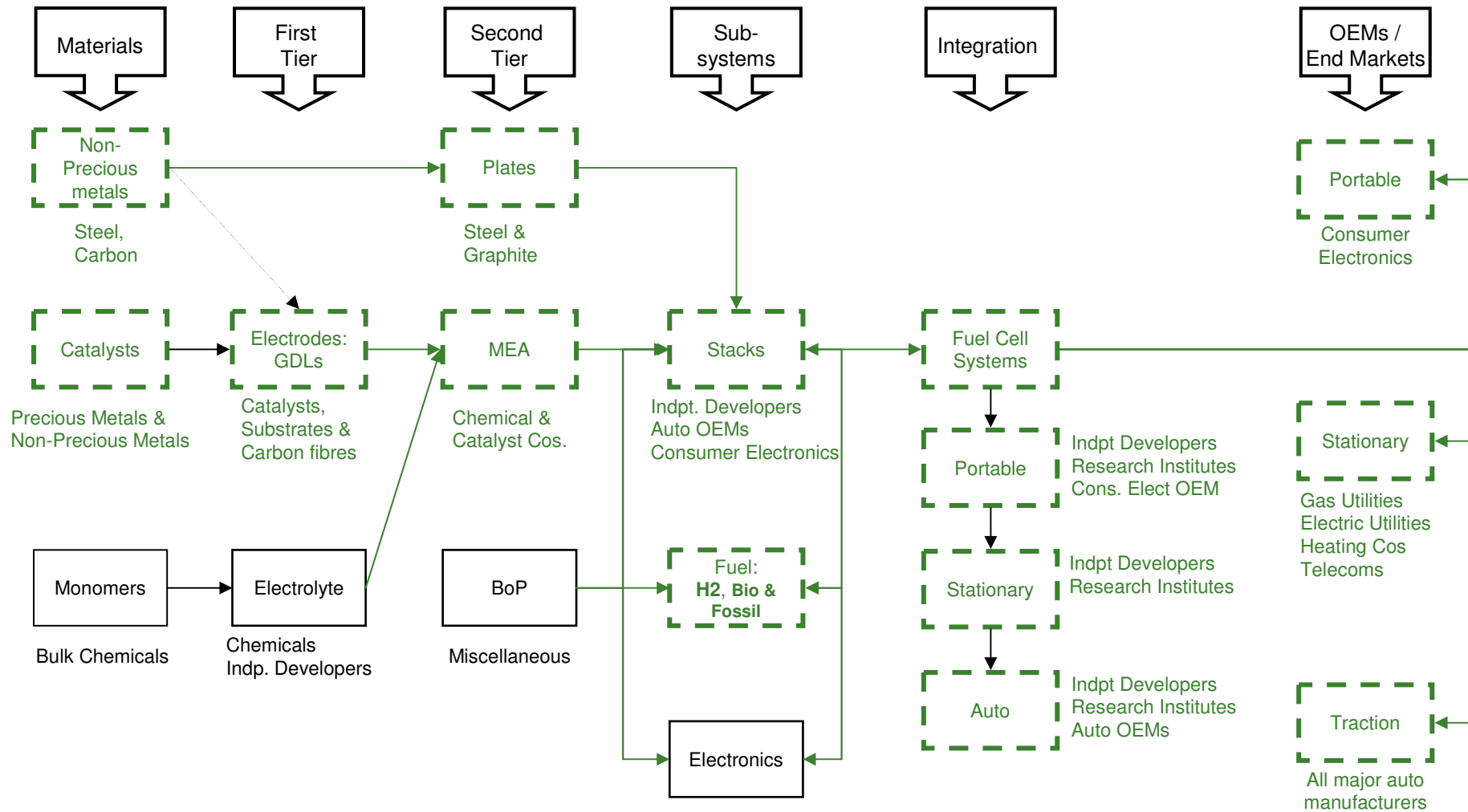


Corporates typically funded from company funds & subsidies, Academics typically funded by governments –

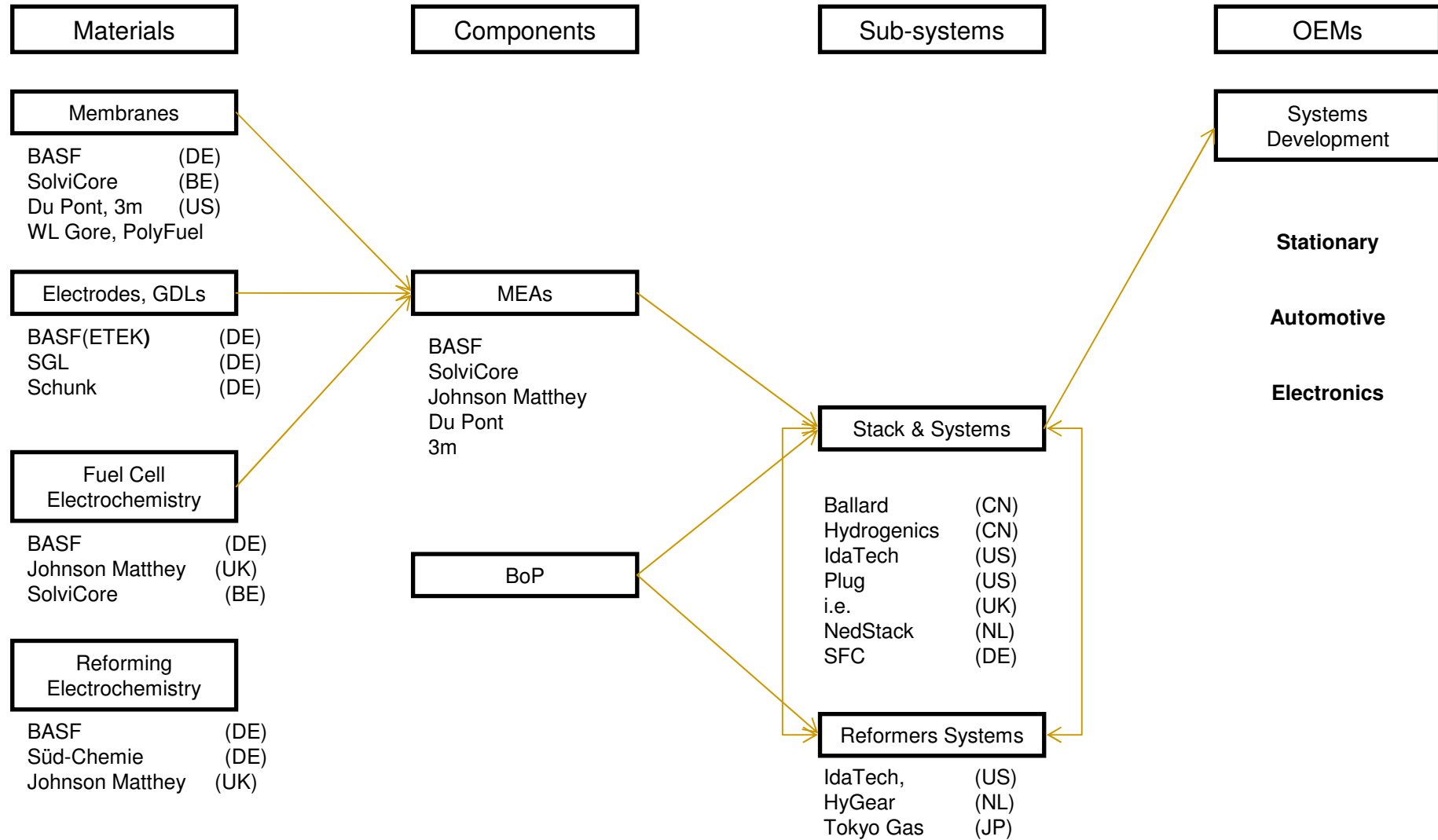
Independents typically entirely dependent on equity funding



Simplified Fuel Cell Industries' Schematic



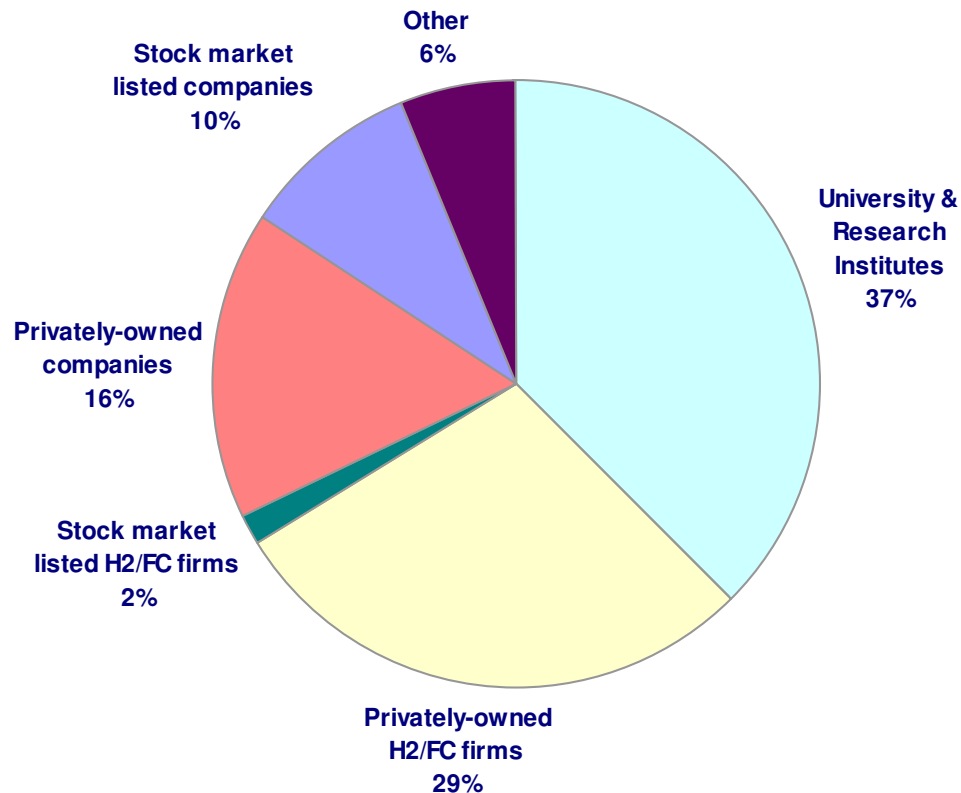
PEMFC Global Company Supply Chain (non-exhaustive)



Structure of the European H2&FC Industry:

Dominated by innovative Independent and Academic organisations

Provisional Data from Roads2HyCom Project*



Nomenclature

- ❖ **“University & Research Institutes”**
Institutions developing H2&FC technologies, e.g. Fraunhofer, ECN
- ❖ **“H2&FC Firms”**
‘Micro-firms’, predominantly focused on the development of H2&FC technologies, e.g. CFCL, Nedstack, P21
- ❖ **“Companies”**
Well-capitalised, economically successful corporates, whose existence is not dependent on the success of H2&FC e.g. Daimler, SGL Carbon, Schunk
- ❖ **“Other”**
Service companies e.g. consultants

Organisational Form

Stock market listed (Corporate) company

Privately owned (Corporate) company

Stock market listed (Micro) firm

Privately owned (Micro) firm

University, Research Institute

Potentially Available Financial Instruments

Debt , Equity, Grants & Subsidies, Tax breaks, Retained Profits

Debt, Grants , Subsidies, Tax breaks, Retained Profits

Debt, Equity, Grants & Subsidies, Tax breaks

Venture Capital, Private Sources

R&D Grants, Industry sponsorship

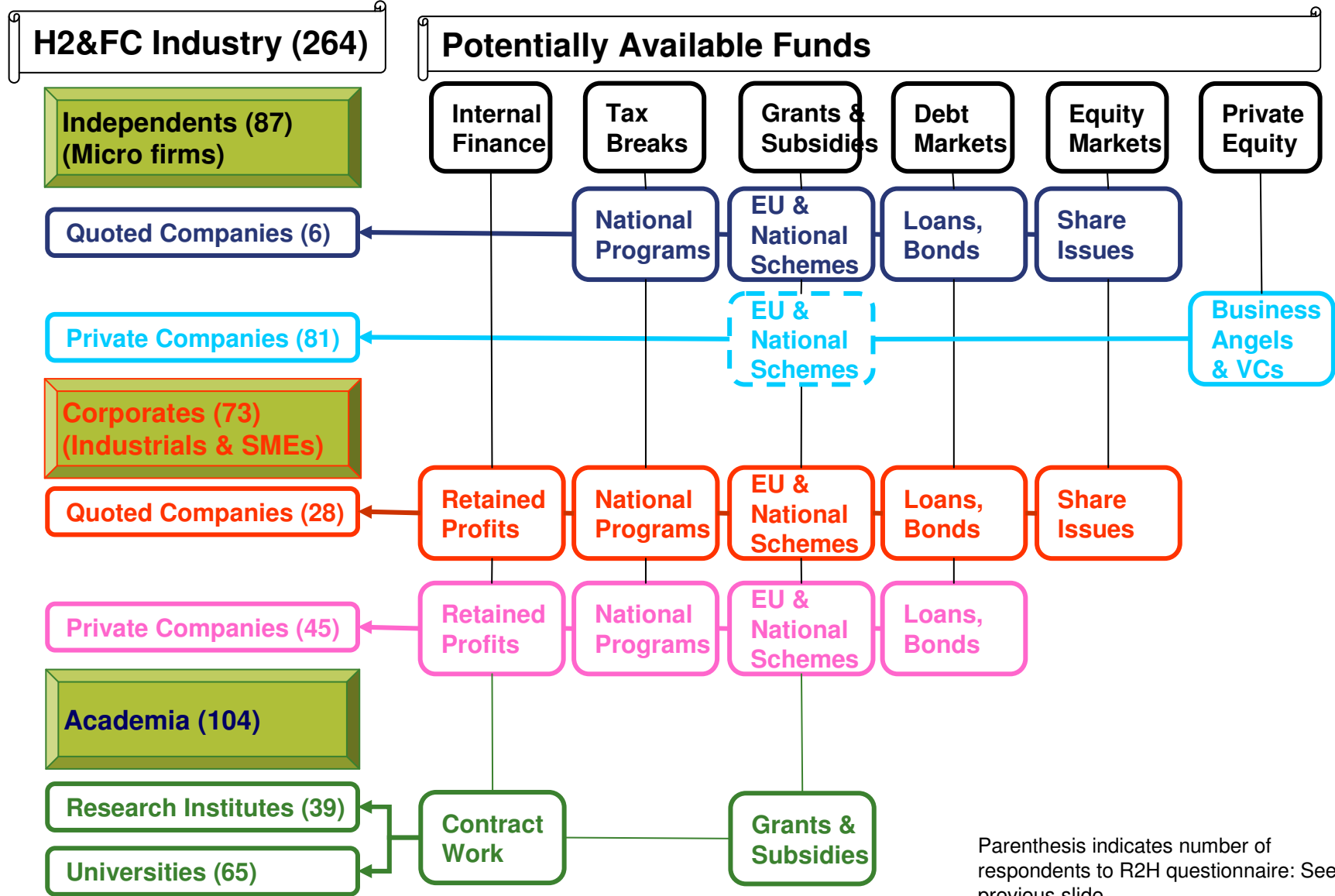
281 respondents gave details of “organisational form”



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•Roads2HyCom is an EU supported consortium charged with describing & analysing the European H2&FC industry

H2FC market structure – Company type & financing instruments



Development Risk and Company Value:

1. Technology Risk: E.g.

- Reactor design
- Catalyst design
- Purification

The technology must support the application which may involve low volume field trials over 2 – 3 year period

2. Large Orders Raise Supply Chain & Engineering Risks

- Reliable –fit for purpose, – components
- Delivered on time
- Joint development of a limited number of key components

Large order provides bargaining power vis-à-vis component (e.g. auto) suppliers

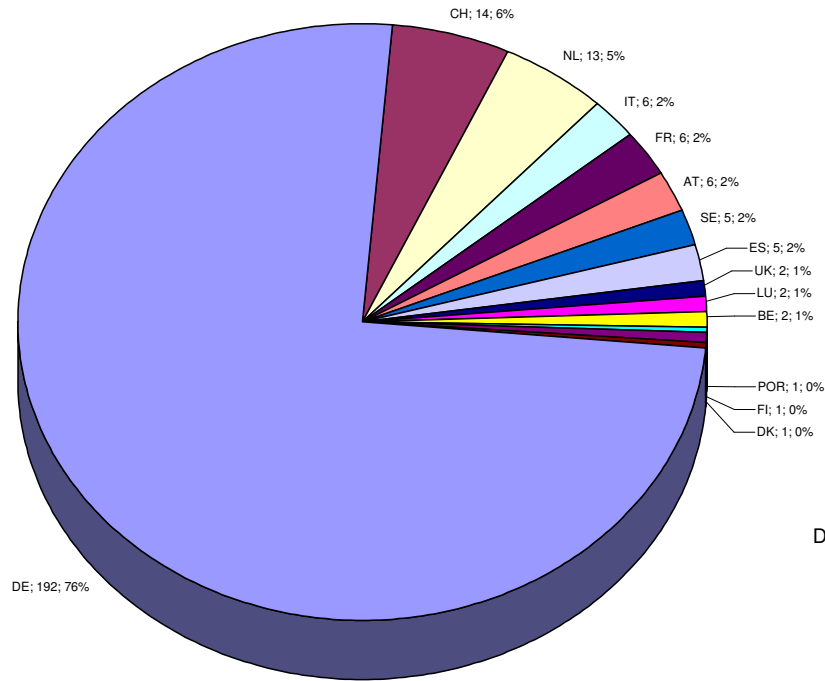
3. Productisation

- Meeting final customer requirements
- Meeting and designed to application appropriate norms

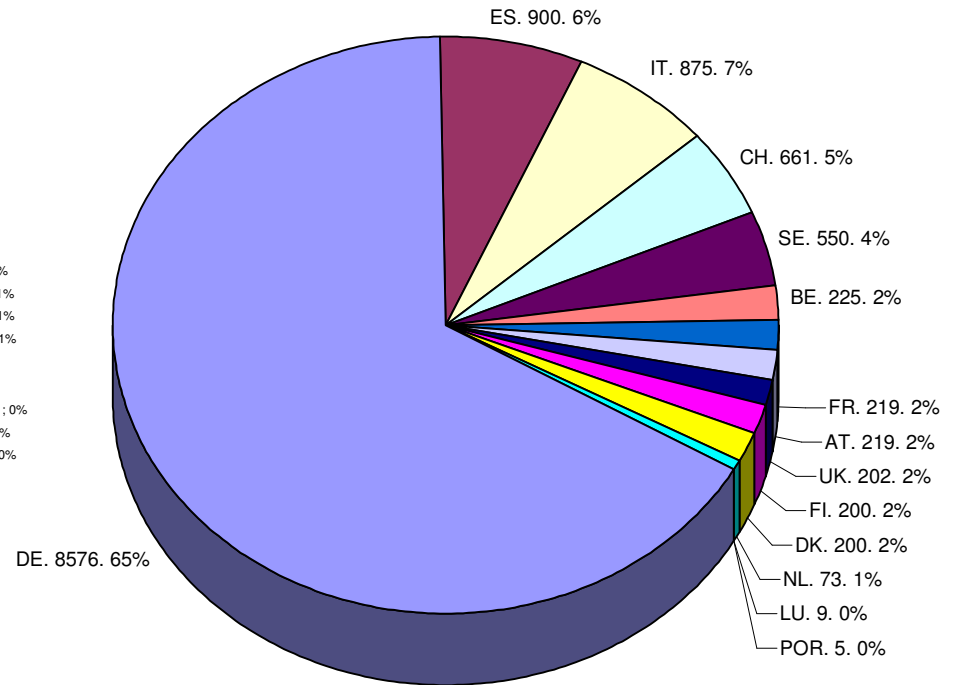


Distribution of Installed FC in Europe (units)

Units

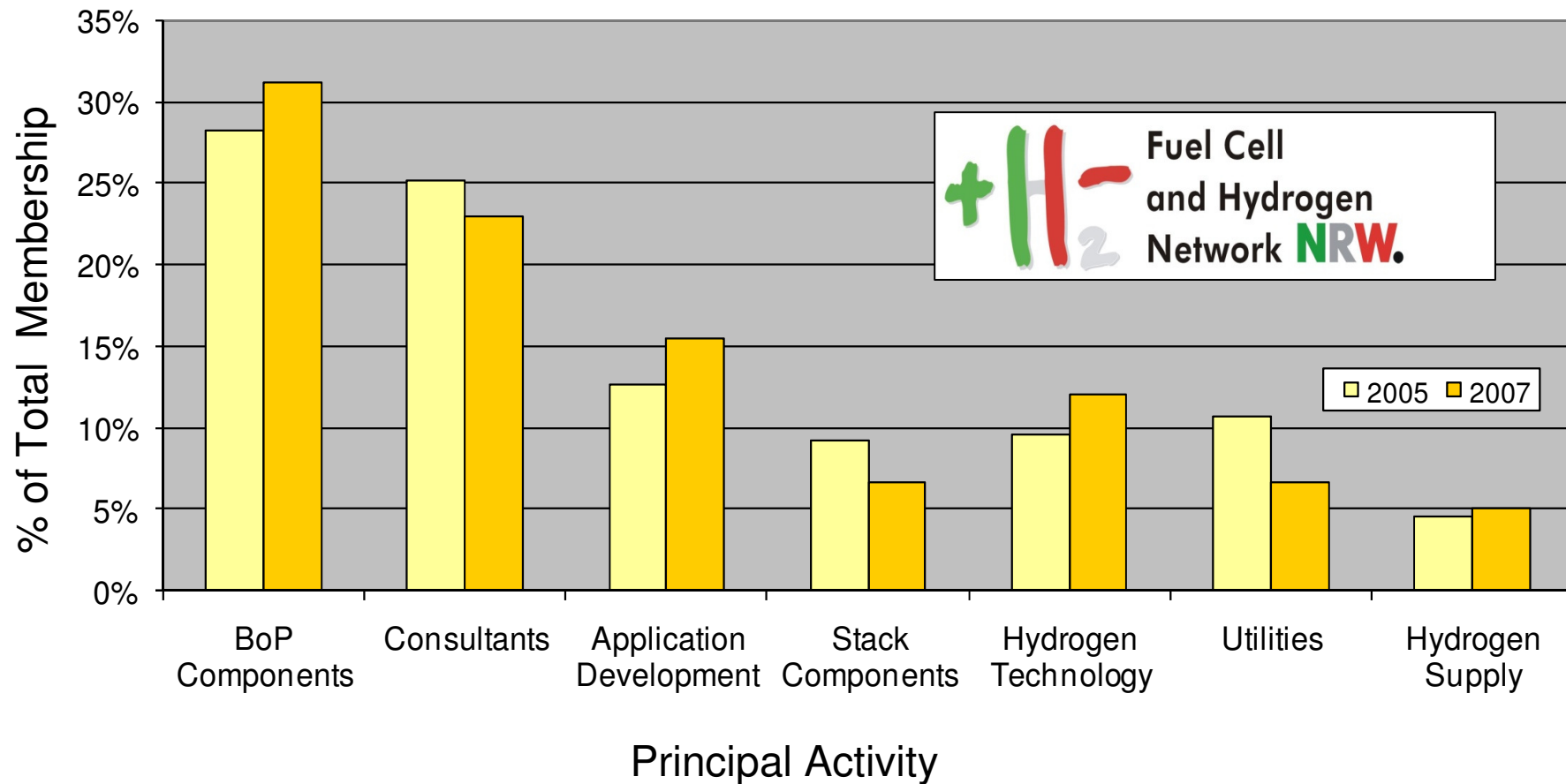


Rated Power (kw)



NRW H2&FC Network by Membership Type

Since early 2000 NRW has provided €80m in H₂&FC subsidies to around 80 projects in the region and built up a network of more than 350 companies spanning the FC chain



Concluding Remarks

- The road to a product is long & demands technical, financial and commercial skills
 - We believe those companies with the greatest sense of financial and commercial realism stand the best chance of success, not necessarily those with the best technology.

- The fuel cell industry encompasses a multitude of varying industries
 - But the fuel cell industry itself is far from mature

- Germany cannot be ignored
 - She has more experience in installing fuel cells than the rest of Europe combined
 - NRW has more experience than any other region & probably the most significant European H₂&FC network

- The value of building a FC network in the absence of international cooperation must be questioned
 - Despite NRW's impressive record its support is based on subsidies, and subsidies can only be used by those most capable of helping themselves, not necessarily those most in need
 - The UK has the most innovative financing instruments available in Europe to provide the only form of finance available to new, innovative companies: equity

- The H₂&FC industry is numerically dominated by independent & academic developers
 - Independent and would-be independent developers can only survive with equity finance

- **Hence there is a need for programmes promoting independent and academic developers**
- **Collaborating with other regions in building networks or supply chains would benefit all parties**

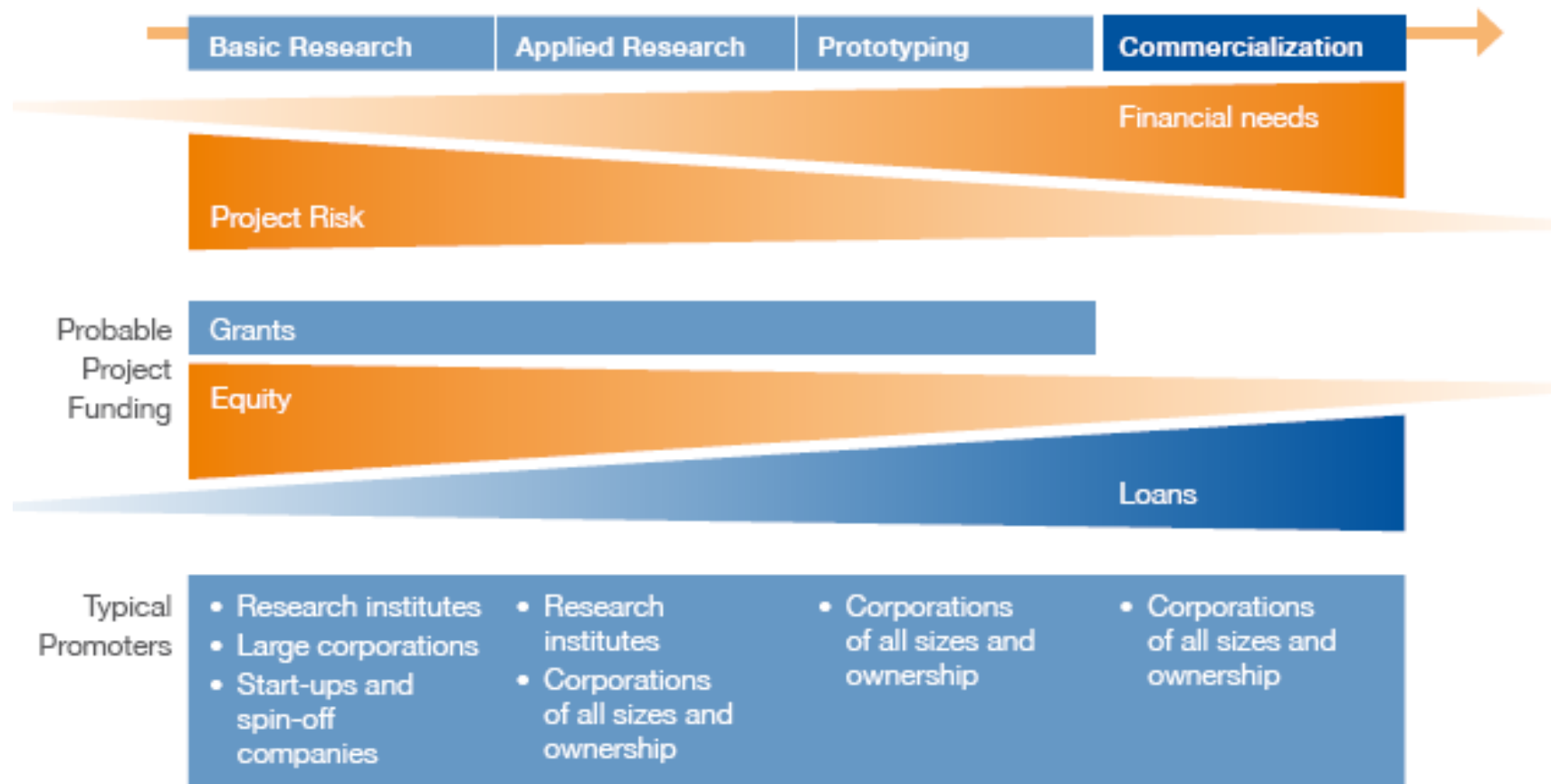


Appendix



Debt & Equity in the Context of Technical Risk

Generic Stages of Research Projects



No Revenues, No Capital → No Debt



Total Equity Raised by Independent Developers up to 2005/6

Independent Quoted H2&FC Companies	R&D Spend to Latest FY \$m (% of total)	Employees FY Latest (% of total)	Equity Raised to end last FY US\$ m (% of total)	Number of Companies
North America	\$176.107 (91%)	2,132 (91.9%)	\$3,360.679 (92.6%)	16
Europe	\$9.525 (4.9%)	89 (3.8%)	\$131.414 (3.6%)	6
Australia	\$7.904 (4.1%)	100 (4.3%)	\$136.303 (3.8%)	1
Total	\$193.535	2,321	\$3,628.396	23



Appendix C: Funding Stages for Privately Owned Technology Developers

- I. **Seed Capital** (Typically raising less than €300,000)
 - a. **Company Characteristics:** 'technology' is a scientific concept with a potential future use which has yet to be practically demonstrated. Risk of failure and thus loss of capital for the investor at its highest.
 - b. **Use of Capital:** to cover the cost of 'proof of concept, to pay salaries, develop the business plan & fund additional technical and market research. Unlikely to meet banks requirements for lending and very few venture capital funds will invest at such an early stage
 - c. **Sources of funds** Friends & Family, maybe business angles

- II. **Start-Up / Early Stage:** (Typically raising less than €3m)
 - a. **Company Characteristics:** business concept technically proven, an outline business plan is in place, although likely based on fairly rudimentary market forecasts. Few, if any, non-scientific members of staff may as yet exist. There have been some high profile, though not public failures by fund managers attempting to raise funds to invest in the sustainable energy industry
 - b. **Start-Up / Early Stage: Use of Capital:** develop the technology from 'proof of concept' to prototype Some patents may be filed or granted. Specialist members of staff, including project engineers and experienced start-up business executives will be hired to enable the start of the transition by the company from technology to product developer. Stricter financial controls will need to be put in place.
 - c. **Sources of funds**, friends & family, specialist early-stage VCs &/or corporate ventures with a strategic interest are active at this stage. Although the broad energy sector is starting to attract the venture capital community, few funds exist with the expertise needed to invest in the H2&FC sector.

- III. **Development Capital/ Expansion Capital:** (Typically raising in excess of €3m)
 - a. **Company Characteristics:** prototype demonstrated. Collaborations established to access addition technology, engineering, routes to market. Most continue to be loss-making, which limits ability to raise debt fom lending institutions
 - b. **Use of Capital:** to participate in the funding of collaborations & expand workforce e.g. marketing and finance. The company may also need to move to more spacious or more convenient premises. The business may also be looking to acquire specialist teams or to acquire businesses to accelerate its growth beyond what is possible organically. Once companies have established the market viability of their product, they often require additional capital to expand and bolster their infrastructure, to accelerate market penetration or to expand into new geographic markets.
 - c. **Source of funds** Venture Capitals, Corporate ventures, hedge funds)

Different actors invest at different stages



Financial Instruments Matrix

	<u>Debt</u>		<u>Equity</u>		<u>Subsidies</u>	
Type of Instrument	Bonds	Mortgages	Publicly traded shares	Privately traded shares	R&D Grants: e.g. EU Framework Grants	Tax Credits: e.g. accelerated depreciation
Examples of users	Institutional Investors, Financial companies	Companies, Home owners	Institutional investors, Private Individuals	Business angels, Venture capitalists, Corporate Venturers	Companies Universities Research Institutes	Companies
Typical Issuers	Companies, Governments	Retail banks Building societies	Quoted Companies	Private Companies	National & local governments, European Union	National & local governments
Constraints	Ability to pay interest & principal	Ability to pay interest & principal	Capacity to generate profits and pay dividends	Ability to show superior technology & management	For companies, proven capacity to match the subsidy	Ability to make profits to benefit from tax credit
Purpose of issue	<p>Debt allows companies to pursue their own interests by leveraging profits with little or no impact on control.</p> <p>Unlike equity, debt can attract tax breaks with interest payments treated as a cost.</p> <p>Typically companies choose a mixture of debt and equity that suits their aims and the current state of the economy. E.g. as interest rates fall companies may seek to finance increased investment by debt rather than issuing new equity to shareholders.</p>		<p>Equity gives companies the freedom to pursue their own best interests in the manner they regard as most appropriate, as well affording them the ability to make use of various government subsidies, such as EU Framework grants.</p> <p>However, subsidies related to income tax relief require a company to generate taxable profits.</p>		<p>Subsidies can allow both governments & companies to pursue social welfare & profit simultaneously by promoting economic growth (jobs).</p> <p>In the case of R&D, subsidies encourage firms to pursue socially beneficial projects that otherwise may be lost to society. The drawback for newly emerging companies is that they often do not have the capital required to match grants nor the profits to benefit from tax breaks.</p>	

