# Commercializing Clean Technology: A Venture Capital Perspective

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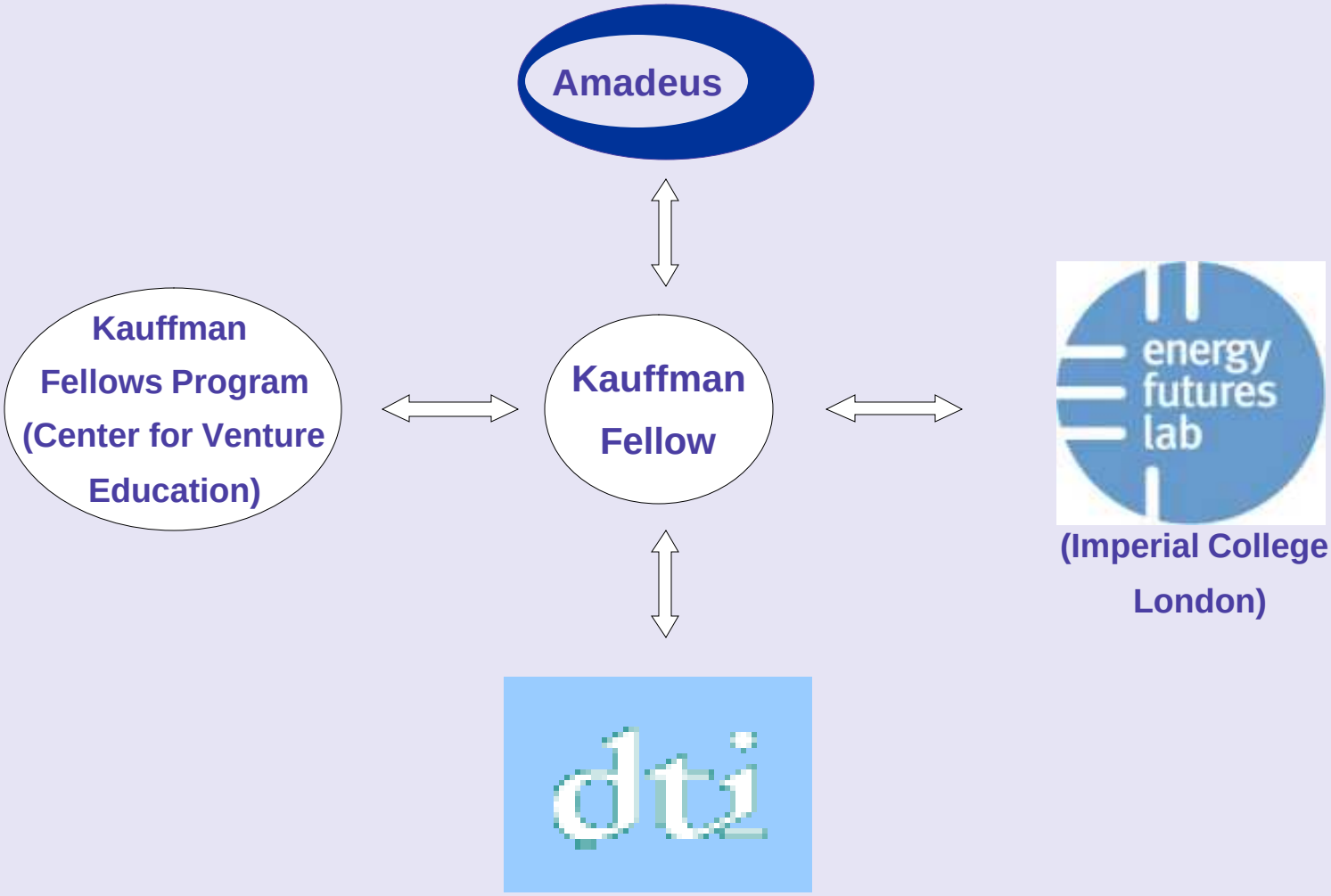
# Agenda

- Project context
- Cleantech Investment Trends
- One VC's Perspective on Sector Attractiveness
  - Sector characteristics
  - Investment Theses
- Concluding Thoughts

# KFP/KTP Structure



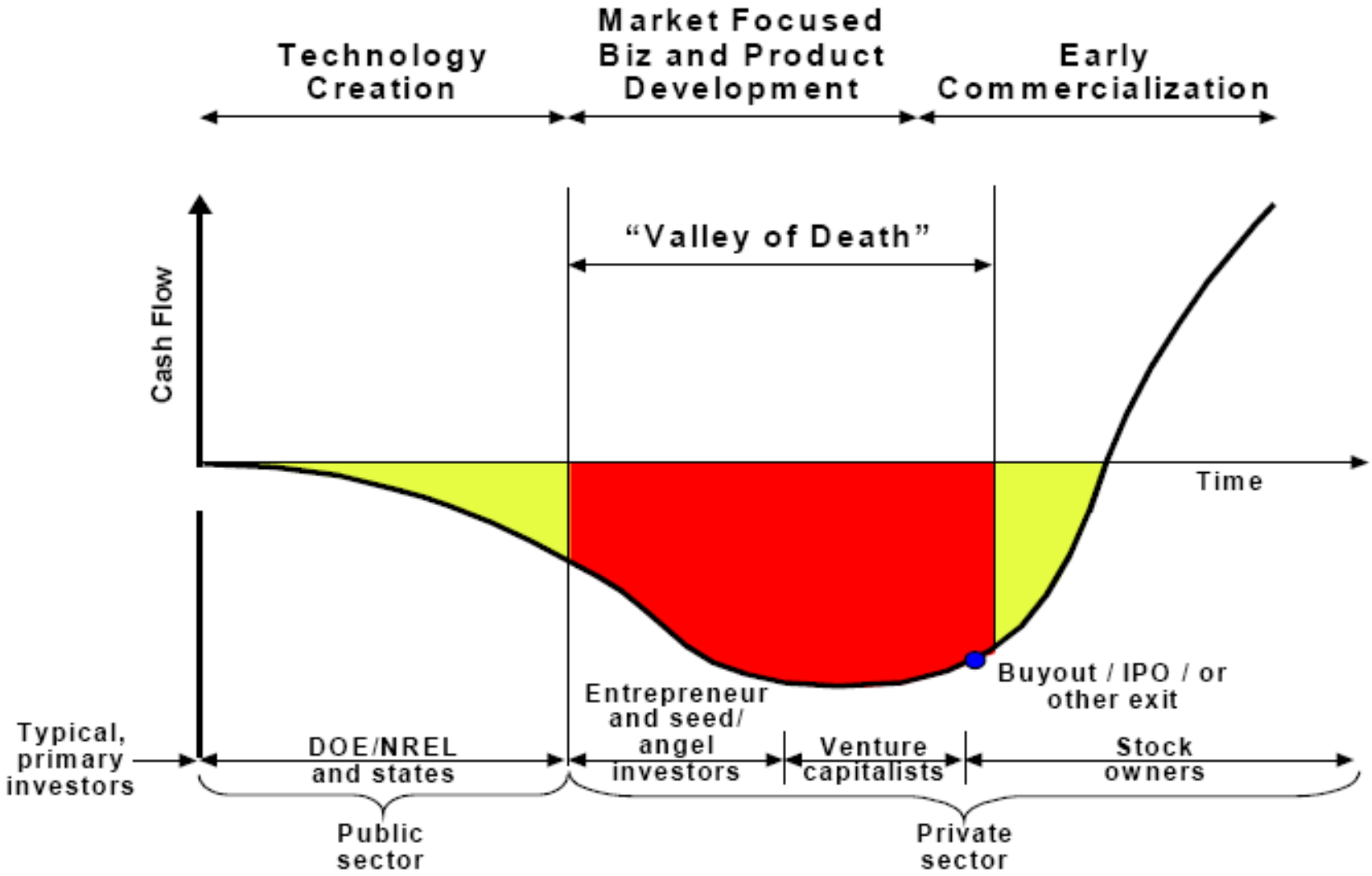
# What is Venture Capital? (1/2)

- VC firms raise funds from LPs (limited partners) and invest on their behalf
  - Typically receive a management fee and a share of the gains
- Invest in technology-based private start-up companies
  - High risk (technology, market, execution), but…
  - High reward: potential for >10X cash returns on winners
  - Significant % of companies don't return investment
    - Technology doesn't work as planned; market doesn't develop, or does so too slowly; team doesn't perform; competition intensifies, etc
  - Goal is to build big, profitable companies, not just have an IPO!

# What is Venture Capital? (2/2)

- Emphasis on novel, defensible technologies with 'order of magnitude' improvements v. conventional approach
  - On cost, speed, quality, convenience, etc.
- Initial investments and follow-on rounds to fund company through to exit
  - 5-7 year investment horizon (typically 10-year fund life)
- Hands-on 'value add' investment approach
  - Take a board seat, drive key decisions, share Rolodex, help raise capital
- Different model and investment criteria than hedge funds, buy-out, corporate venturing, angel investors, corporate R&D, government R&D, etc.

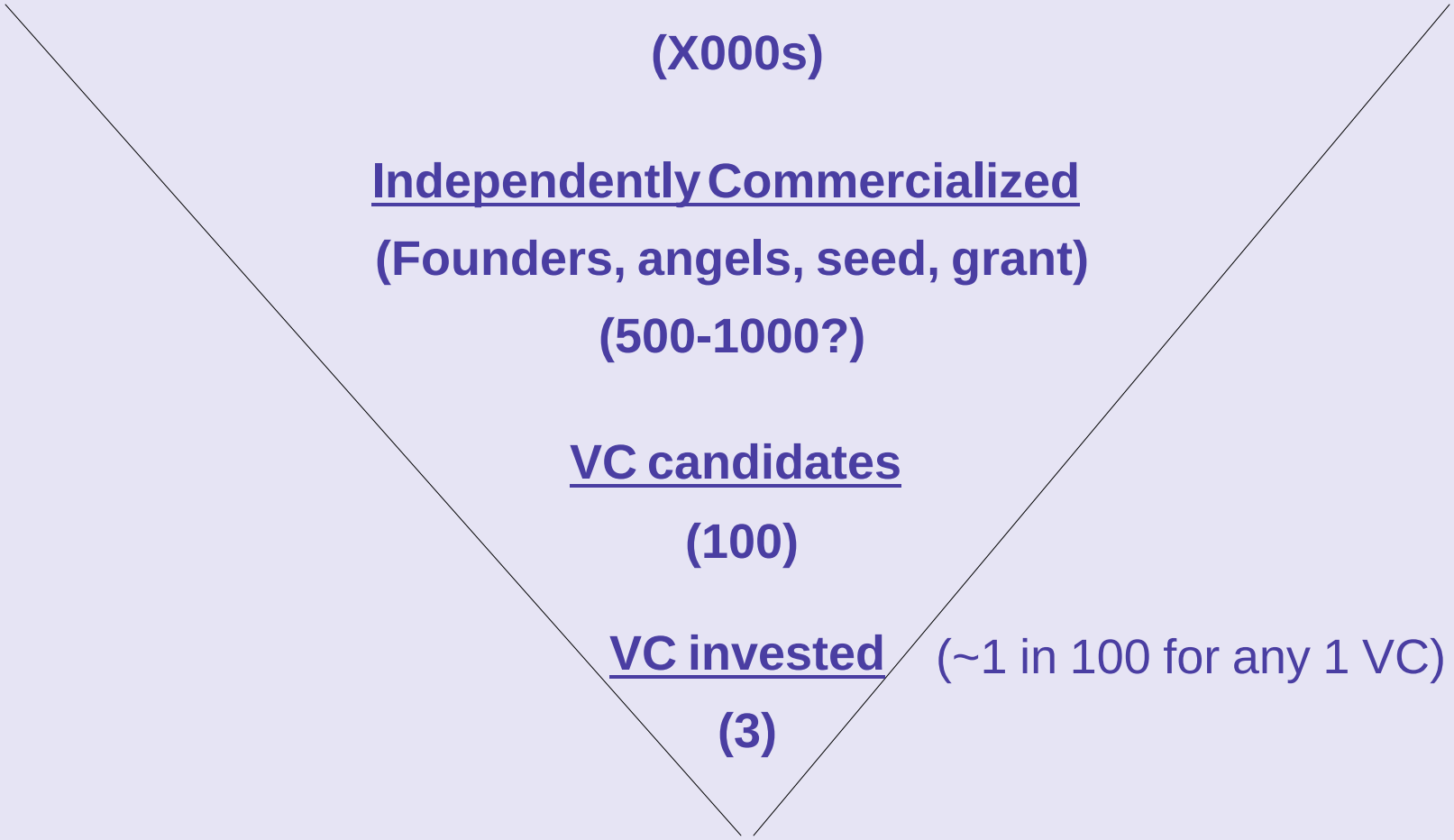
# Traditional Technology Funding Cycle






Source: Murphy, L.M. et al, NREL (2002)

# Technology Commercialization Funnel (Schematic)




(~1 in 100 for any 1 VC)

# Amadeus Capital Partners, Ltd

- A leading UK technology venture capital firm
  - Offices in London and Cambridge
- Founded 1997
- Three main funds and two seed funds
- ~£460m ($900m+) under management
  - Current fund is £162m
- Have invested in ~60 companies in 10 years
- Invest in UK, Europe, and Israel
- Focal sectors
  - Telecoms, IT, Semiconductors, Med Tech, Cleantech
- Successes:
  - Cambridge Silicon Radio, Solexa, Optos
- Interesting ‘cleantech’ deals (according to some):
  - Plastic Logic, Power Paper, Power ID, Liquavista

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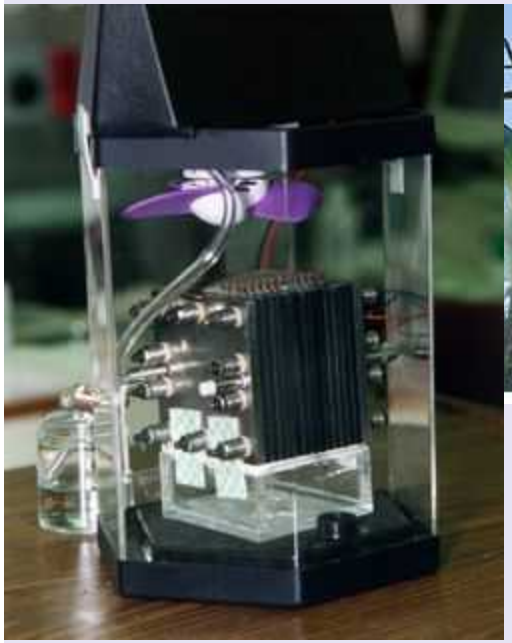
# What is cleantech?



# Major Cleantech Categories (Amadeus take)

| Energy | Water | Pollution & Waste | Industrial | Consumer |
|---|---|---|---|---|
| • Electricity Generation<br>• Storage<br>• Efficiency and management<br>• Fuels<br>• Biomass/CHP/ Syngas | • Treatment & Purification<br>• Distribution & Reclamation<br>• Desalination | • In situ pollution (Air, Soil, Water)<br>• Carbon<br>• Industrial Waste<br>• Consumer Waste (eg MSW, tyres) | • Automotive<br>• Manufacturing & Industrial<br>• Bio/Chemical<br>• Transport & Logistics<br>• Agriculture & Forestry | • 'Green' consumer goods and services |

## Key Enabling/Crossover Technologies

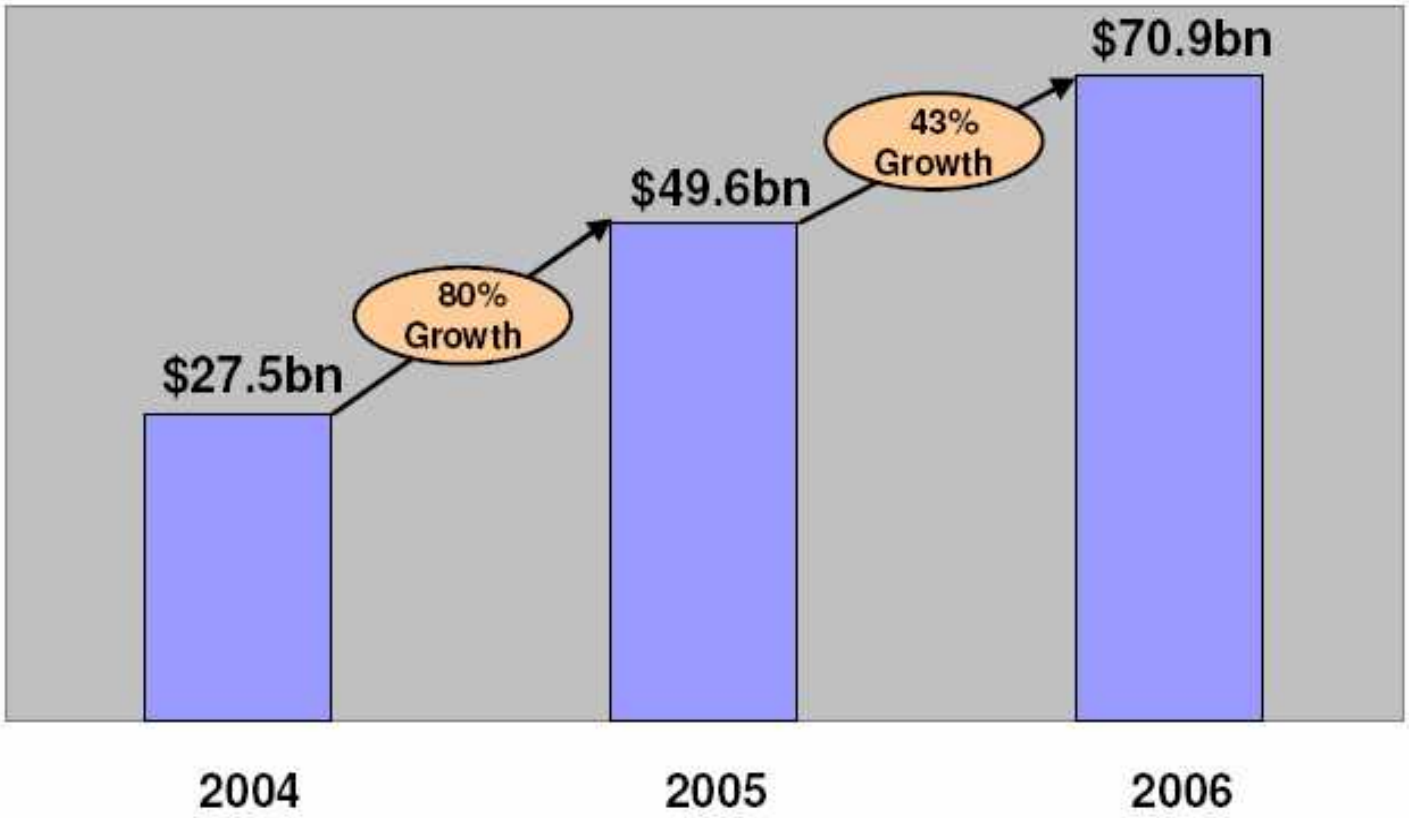
- **IT**
- **Advanced Materials & Chemistry**
- **Life Sciences/Biology**
- **Semiconductors**
- **Process Technologies**

# Why Cleantech/Clean Energy?

- **Compelling long-term macro drivers**
  - Rising global demand (and prices) for energy; increasing de/re-regulation; energy security
  - Commodity, materials, and resource supply constraints
  - Urbanization
  - Increasing environmental pressures eg climate change (and increased willingness to pay by society)
  - Technology innovation and cross-over
- **Demonstrated success**
  - Large and growing markets (eg solar, biofuels)
  - Some major exits
- **Strong overlap with Amadeus strengths, portfolio, and relationships**
  - Cross-over with existing domain expertise (semis, IT, optics, physics, manufacturing and ops)
  - Power Paper, Plastic Logic, Liquavista, Nujira, Acol
  - Significant research/tech. ties (eg Cambridge, Imperial, portfolio companies)

# Huge Growth in Global Clean Energy Investment (*Technology, projects, and infrastructure)*

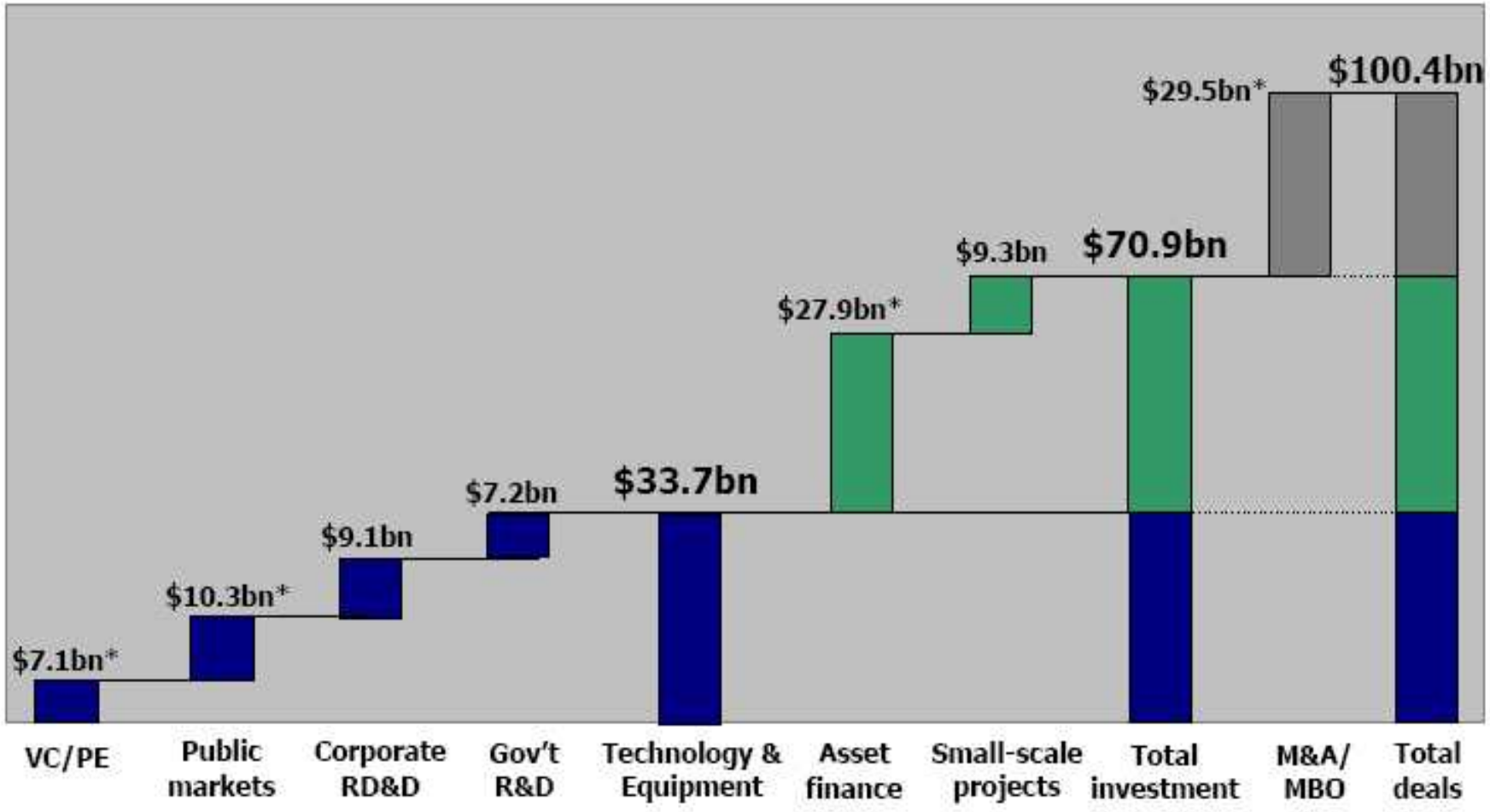
## Global Investment in Clean Energy 2004 - 2006




Grossed-up estimate based on disclosed deals. New investment only.

Source: New Energy Finance

# Global Investment, M&A and Refinancing in Clean Energy, 2006, by Type of Transaction

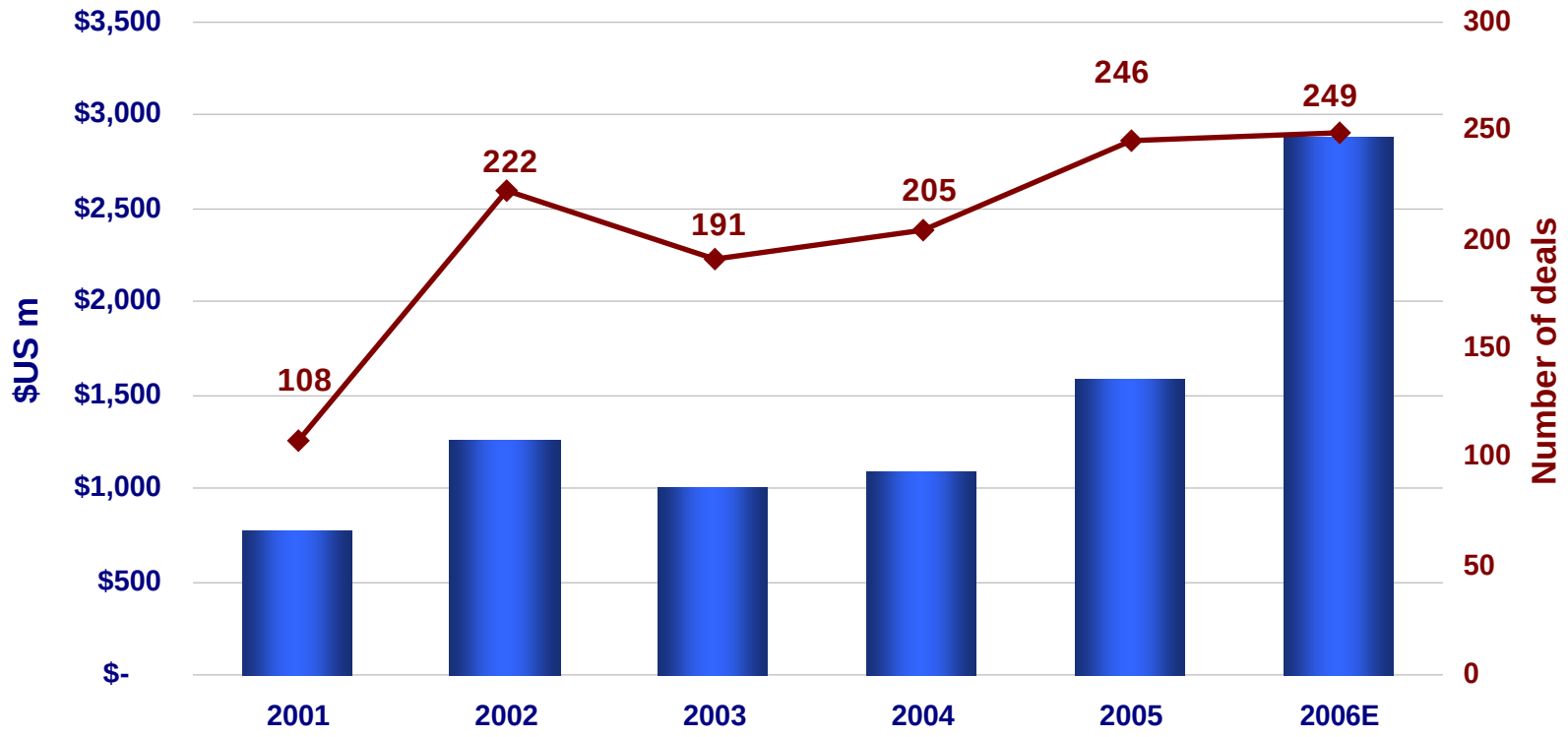



Figures marked * are based on NEF Desktop databases; all other figures based on industry estimates based on various sources.

Source: New Energy Finance

# North American Cleantech VC Investment

- ***2006 N.A. Cleantech VC investing broke records for number of investments, dollar volume, and average investment size***
- ***Cleantech was #3 North American VC investment category in 2006***




| Average Investment: | $7.2M | $5.7M | $5.3M | $5.4M | $6.5M | $9.6M |
|---|---|---|---|---|---|---|

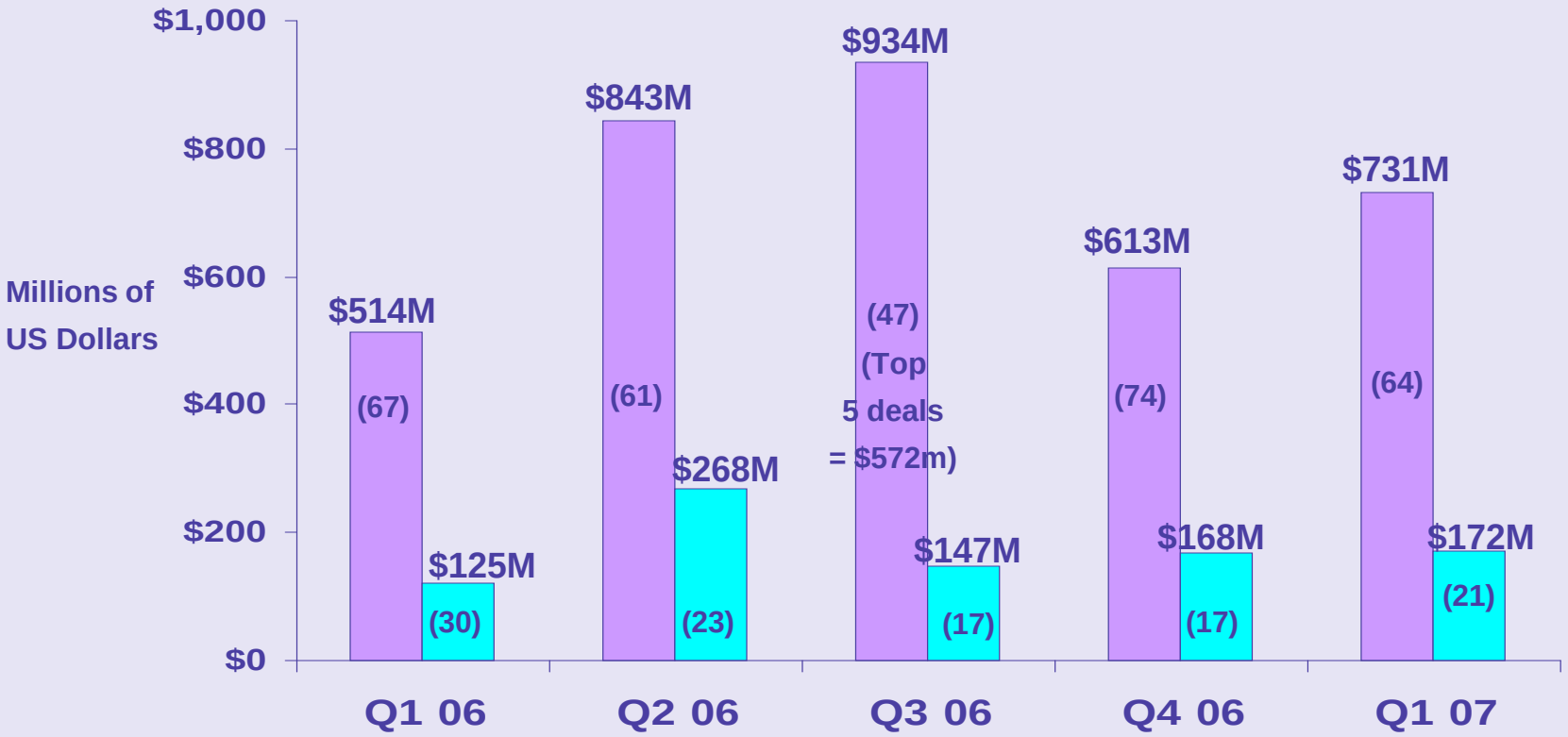


Source: Cleantech Venture Network; Amadeus estimate

# North America vs. Europe Cleantech VC investing

*European Cleantech VC investments appear to be 20%-30% of the North American total, depending on the quarter*

*(Similar ratio as for non-cleantech VC)*






Source: Cleantech Venture Network

# Top European Cleantech VC Deals 2006

| | | | | |
|---|---|---|---|---|
| Wave Dragon (Denmark) | Electricity – Generation | Wave Power | $31MM | KP Renewables plc (Kwik Power International) |
| Ocean power Delivery (Scotland) | Electricity – Generation | Wave Power | $24MM | SAM, Carbon Trust, GE Capital, New Energies, Partnerships UK, Impax, Environmental Markets, Merrill Lynch, SEP, Sigma, Sustainable Performance Group, Tudor Group, Vantania Holdings, Commons Capital |
| Norsun (Norway) | Electricity – Generation | Solar | $23MM | Hydro Technology Ventures |
| Keronite Ltd. (UK) | Industrial & Automotive | Coatings and surface treatment | $19MM | Bank of Scotland, Fidelity Investments, New Star, Quester, RAB Capital |
| SFC Smartfuel AG (GER) | Electricity - Generation | Direct Methanol Fuel Cells | $19MM | Undisclosed, 3i Group |

| | | | | |
|---|---|---|---|---|
| Econcern BV* (NED) | Electricity – Generation, Trans., Svcs. | Alternative energy provider, project developer, svcs | $102M | SHV (Netherlands utility); Entrepreneurs Fund BV |



*** Not truly a VC or technology investment**



Source: Cleantech Venture Network; New Energy Finance; general trade

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# Core Investment Criteria

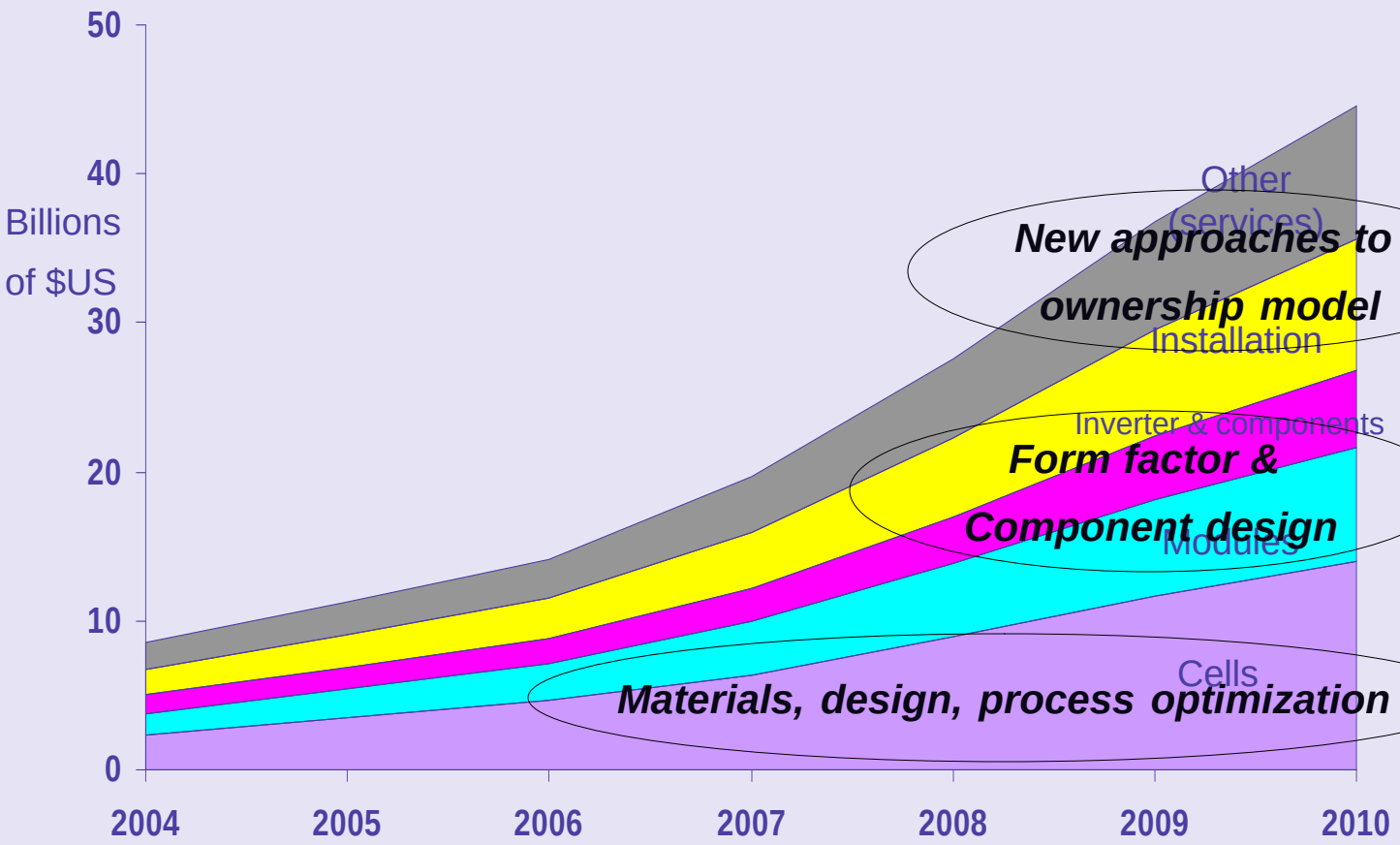
- Big, growing market ($1B/year or more)
- Top-notch team
  - At least one star
  - Past success is a big help!
- Novel, defensible technology with a big competitive advantage (better/faster/cheaper)
  - Versus competing startups
  - Versus conventional alternatives
- Unmet Customer Need/Pain Point
- Profitable Business Model
  - Control the value

# Additional Considerations

- Capital efficiency
- Time to market
- Exit prospects
- New interface vs. ‘plug and play’
- Industry competitive landscape
- Surrounding industry ecosystem
- Market conditions
- Policy/regulatory environment
- Location
- Other investors
- Other factors
  - Eg is it ‘Clean’?

# Big, growing market with lots of innovation

*The solar industry is forecast to grow from a ~$15B market today to $30B-40B in 2010*




| | Market size 2010 | 2006 Pre-tax Margin |
|---|---|---|
| Other (services) | $6-9B | 5% |
| Installation | $6-9B | 20% |
| Inverter & components | $3-5B | 17% |
| Modules | $5-8B | 11% |
| Cells | $12-15B | 20% |



*Source: Jefferies; Merrill Lynch, CLSA, Photon International*

# Proven exits

## IPOs

- **Q-Cells: IPO Oct. 2005 – raised $376m on $1.7B post-money**
- **REC: $1.2B raised on $6B valuation (10x sales) in May 2006**
- **First Solar: raised $400m Nov 2006**
- **JA Solar (China): raised $225m on $600m in Feb 2007**
- **And more: SunTech, Ersol, SunPower, SolarWorld AG, ECD, Evergreen, Motech…**
- **5 largest public solar companies market cap >$20B**
- **IPO trend shift for 2007-2008**
  - **European Si players already public**
  - **Next waves likely to be: China, CIGS/thin-film, Supporting Industries (eg mfg. eqpt.)**

## M&A

- **First in a possible wave of forward integration = SunPower buys PowerLight in Q4 ’06. Other installers on notice**

# Growth is driven largely by subsidies/incentives

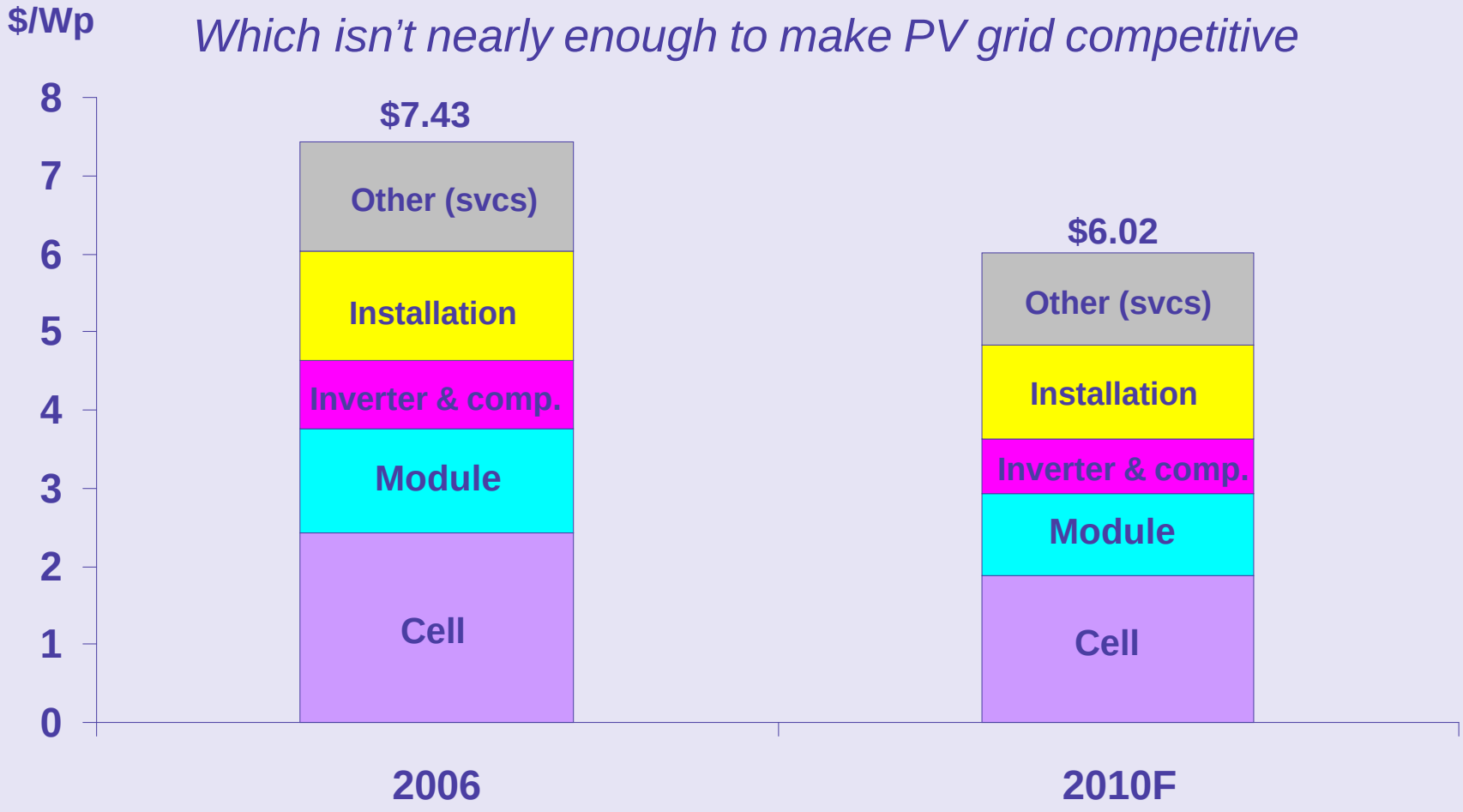
| | |
|---|---|
| • **Japan** | • Mostly eliminated; market still growing 15-20% p.a. |
| • **Germany** | • €.518/kWh FIT in 2006, declining 5% p.a. for 20 yrs (2022) |
| • **Spain** | • €.42/kWh FIT <100MW; €.22/kWh >100MW for 25 yrs<br>• More sunlight = 80% more power from same system v GER<br>• Solar thermal requirement (30-70% for new & renovations) |
| • **Greece & Italy**<br>• **France** | • New FITs – Italy installs fixed 20-yr FITs of €.36-.49/kWh, with goal of 3GW installed by 2016<br>• FITs of €.225-.30/kWh |
| • **China** | • 5% renewables by 2010; 10% by 2020 (7.5GW installed) |
| • **US**<br>• **States** | • 30% tax credit: no cap comm'l; up to $2k/yr residential<br>• CA Solar Initiative: Million solar roofs; Rebate = $2.80/W<br>• NJ, TX, MA, etc. |

***Key policy features = FIT (or other), Interconnect, and Net-metering***

# Silicon PV Cost per Watt-peak 2006-2010

*Cost per Wp for Si PV is expected to drop 19% by 2010…*

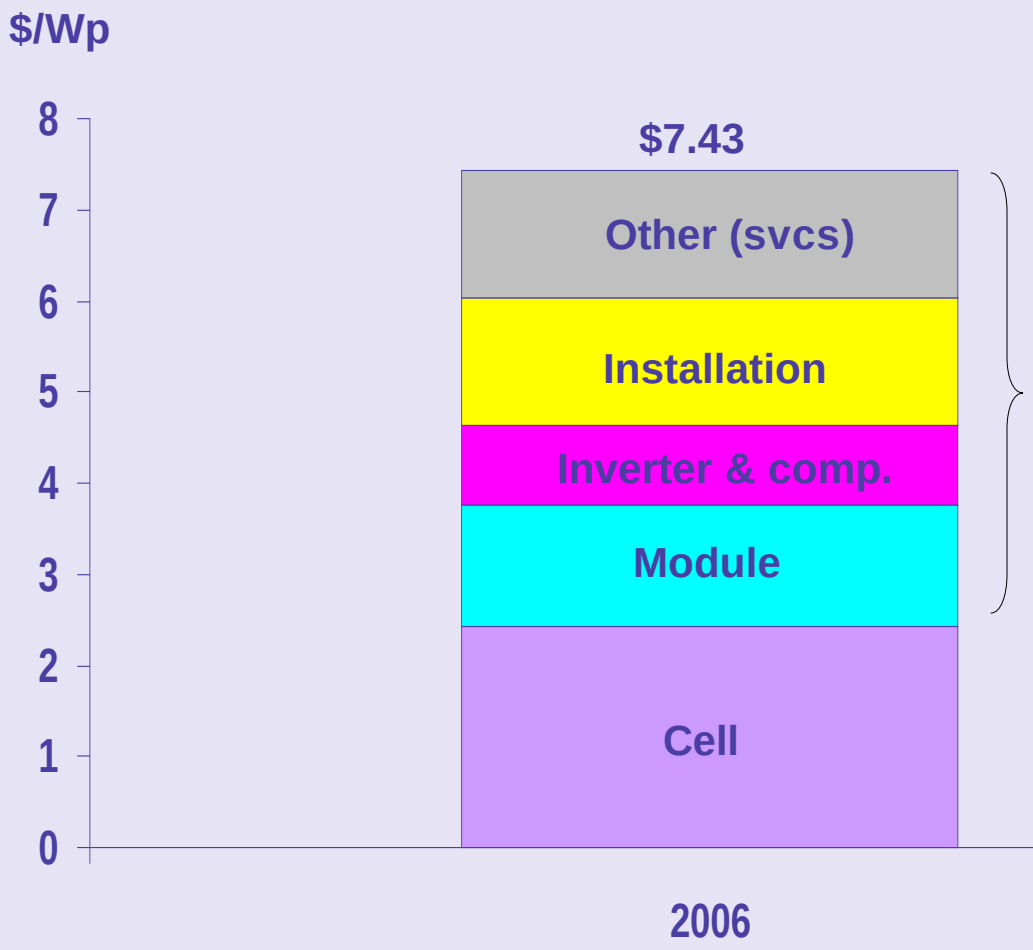
*Which isn't nearly enough to make PV grid competitive*






*Source: Jefferies; Merrill Lynch, CLSA, Photon International*

# *Conclusion 1: 3-5X Cost reduction will have to address the entire form factor*




- **Fundamentally change form factor and supply chain**
- **(Component cost reduction)**
- **Increase efficiency**

  **and**
- **Reduce cell cost**



*Source: Jefferies; Merrill Lynch, CLSA, Photon International*

# *Conclusion 2: Many winning formulas – find the right fit for each end-use case*

**Parameters**

- **Cost/m^2**
- **Efficiency**
- **Lifetime**
- **Form-factor**
- **Durability/toughness**
- **Complexity/reliability**
- **Scale**
- **PV, thermal, CHP**
- **Natural light or concentated**
- **With or without storage**

**Use case variables**

- **Available area**
- **Peak load**
- **Desired lifetime**
- **Portable v stationary**
- **Protected v every-day**
- **Easy access v remote**
- **Device vs. city**
- **Grid, private, residential**
- **Sunny or cloudy?**
- **Load curve**

**+ Desired Price point**

# Solar Summary: Things to Like

- Big, high-growth industry with lots of innovation up and down the value chain
- Fundamentally global, highly scaleable business
- Serious commitment (apparently) from policymakers to promote solar
- Relatively easy/fast route to market
- Very successful exits and healthy investor appetite (for the moment)
- Industry ecosystem filling out (upstream, downstream, project finance, etc.)
- Energy balance >1

# Negatives/Risks in Solar

- Commodity manufacturing business
  - Little/no recurring revenue
  - Emphasis on cost reduction and scale (low GMs in long run)
- Input commodity constraints and volatility (eg Silicon, Indium)
- Fundamentally reliant on subsidies (for now)
- Very competitive commercial marketplace
- Competitive investor landscape
  - Easy to grasp, similarities to semiconductors
  - High valuations!

# Major Cleantech Categories

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|---|---|---|---|---|
| • Electricity Generation<br>- Solar<br>• Storage<br>• Efficiency and management<br>• Fuels<br>• Biomass/CHP/ Syngas | • Treatment & Purification<br>• Distribution & Reclamation<br>• Desalination | • In situ pollution (Air, Soil, Water)<br>• Industrial Effluence<br>• Isolated waste (eg MSW, tyres)<br>• Carbon | • Manufacturing, Industrial<br>• Bio/Chemical<br>• Transport & Logistics<br>• Agriculture & Forestry | • Consumer goods and services |

## Key Enabling/Crossover Technologies

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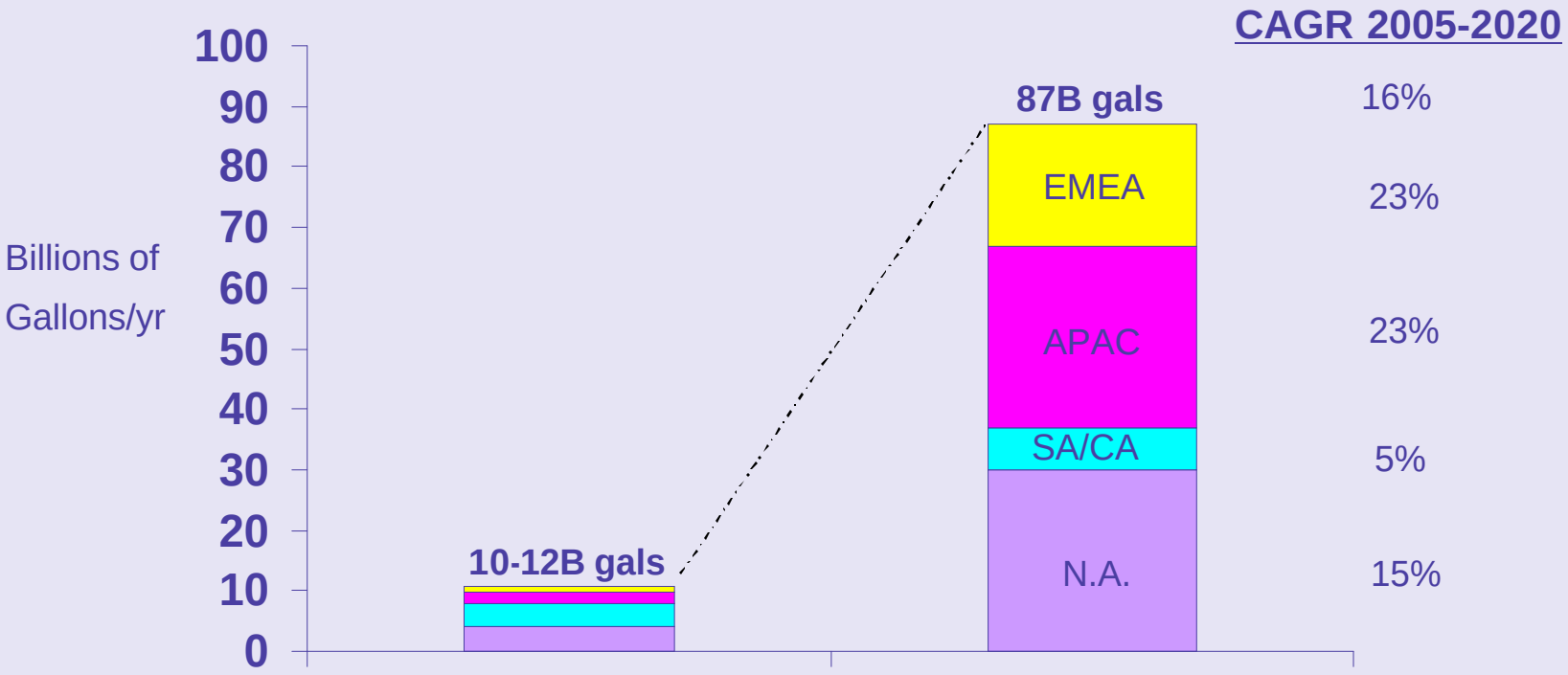
- **Semis**
- **Process Technologies**

# Global Biofuels Growth Forecast




**Market size At $2/gal:**

**~$20B**

**~$175B**



Source: DuPont, JP Morgan. Jefferies;

# High-level cost Comparison and Energy Balances


| | Petrol (@$60/b) | Soy BD | Waste Grease BD | Cane Ethanol | Corn Ethanol | Cellulosic Ethanol (2012) |
|---|---|---|---|---|---|---|
| Net Energy Balance: | ~5X | 1.9X-3.2X | >2X | ~10X | ~1.3X | 4-5X |



Source: DuPont, JP Morgan. Jefferies;

# ‘Green Chemistry’

**Old Processes**

**Petroleum feedstocks**

- Depletive
- Extractive
- Emissive

**Thermo-chemical catalysis**

- Multi-step
- Compounding yield loss
- High energy penalty

**Toxic end-product and by-products**

- Transport
- Disposal
- Recovery
- Emissions

**New Processes**

**Biomass feedstocks**

- Renewable
- Low-value waste

**Biological conversion**

- Parallel
- Naturally high yields
- Lower energy penalty

**Degradable/ designer end products**

- Optimize product mix
- Optimize eg combustion characteristics

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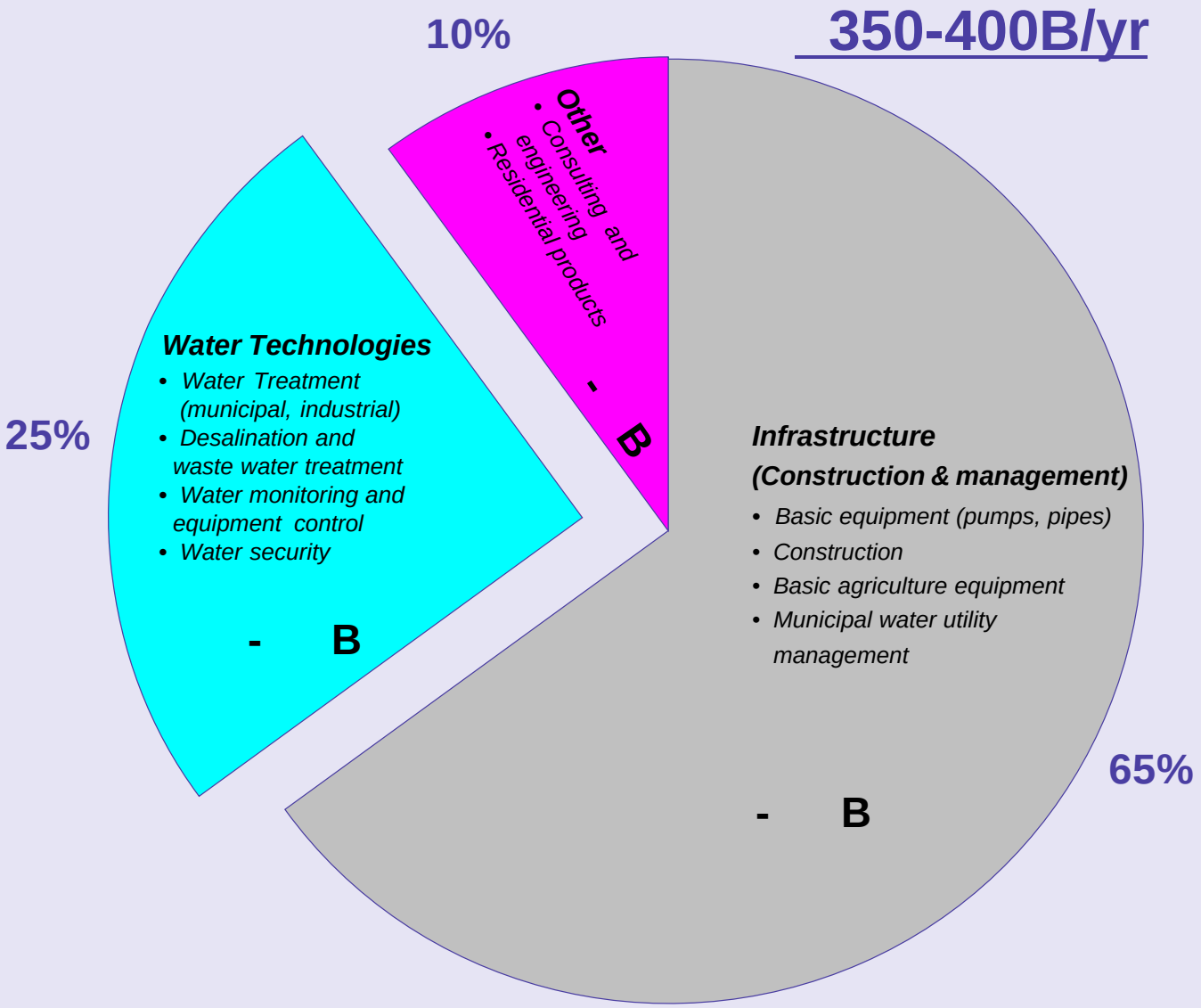
# Water





Unattributed from various sources

# Water Investments – Pros & Cons

## Pros

- Huge global market with some high growth niches
- Major infrastructure drivers:
  - Upgrades in OECD countries
  - New infrastructure in LDCs
- Previously low-tech industry and lots of low-hanging fruit
  - eg Thames Water 35% leakage
- Active M&A market in recent years
- Less competitive than other cleantech sectors

## Cons

- Long selling cycles and risk-averse customers
  - Old technologies are cheap and work pretty well
- Capital intensive business
- Generally unattractive business models (eg selling kit)
- Few disruptive technologies, and many people following similar approaches (eg UV, membranes)
- To date, lacks policy urgency of climate change
- Low valuation/exit multipes

**But back to the first point:**

***Huge global market with lots of low hanging fruit!***

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# High Level Thoughts

- Multi-decade trend to rebuild OECD capital infrastructure and construct huge new infrastructure in developing economies
  - De-carbonize
  - Raise efficiency / reduce waste
  - Trillions of dollars of capital investment over next 2-3 decades
- Urgency derives from multiple sources
  - Resource shortages and discontinuities (water, energy, raw materials)
  - Security (Geopolitical and economic)
  - Environmental pressures
- Technology convergence enabling entirely new approaches
  - Examples: IT + power industry; Directed evolution + fuels; and so on
  - Reveals lots of new low-hanging fruit

***Fertile investment ground for decades to come***

# Thank You!


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