European Cleantech and Bioenergy

29 Oct 2007

Pat Burtis – Amadeus Capital Partners Ltd

Amadeus Capital Partners, Ltd

- A leading UK technology venture capital firm
  - Offices in London and Cambridge, UK
- Founded 1997 by Hermann Hauser and Anne Glover
- Focal sectors
  - Telecoms, IT, Semiconductors, Med Tech, Cleantech
- Stage agnostic – comfortable with early-stage technology risk
- Three main funds and two seed funds
- ~£460m ($900m+) under management
  - Current fund is £162m
- Have invested in ~60 companies over 10 years
- Invest in UK, Europe, and Israel
- Interesting ‘cleantech’ deals:
  - Plastic Logic, Power Paper, Power ID, Liquavista

Agenda

- Cleantech Investment Rationale
- Cleantech Investment Trends
- Interesting Bioenergy Sectors
  - Biofuels
  - Gasification
- Concluding Thoughts

Major Cleantech Categories (Amadeus take)

Energy	Water	Pollution & Waste	Industrial	Consumer
• Electricity Generation • Storage • Efficiency and management • Fuels • Biomass/CHP/ Gasification	• Treatment & Purification • Distribution & Reclamation • Desalination	• In situ pollution (Air, Soil, Water) • Carbon • Industrial Effluence • Isolated waste (eg MSW, tyres)	• Manufacturing, Industrial • Bio/Chemical • Transport & Logistics • Agriculture & Forestry	• 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)

Why Europe/UK?

- **Dealflow**
  - Strong European technical platform for spinouts
    - Academic (Cambridge, Oxford, Imperial, etc)
    - Corporate (Siemens, Phillips, Volvo, etc)
    - Govt and Quasi-Govt (Fraunhofer, VTT, Carbon Trust, etc)
  - Lots of 'stealth' or undiscovered cleantech companies with significant progress (eg pre-date 'cleantech' boom)
- **Favorouble regulatory environment**
  - Kyoto/ETS, EU Waste Directive, Solar Subsidies, Euro X auto regs, etc
- **Favourable consumer environment (versus US)**
- **Less competition, more cooperation among investors**
  - Valuations still sane (Consider early stage US solar deals @$300m+)
  - Enthusiasm for syndication and cooperation amongst VCs (so far)
- **Some strong exits**

Europe/UK Cleantech Challenges

- Lack of strong managers
  - Fewer serial entrepreneurs than US
  - Cleantech sector very new here
  - Different entrepreneurial ambitions
- Fragmented markets and inherent trade barriers
  - Different regulatory regimes and markets
  - Language and cultural differences
  - Legal complexity
- Nascent venture capital infrastructure
  - Smaller funds, smaller rounds
  - Few pan-European funds

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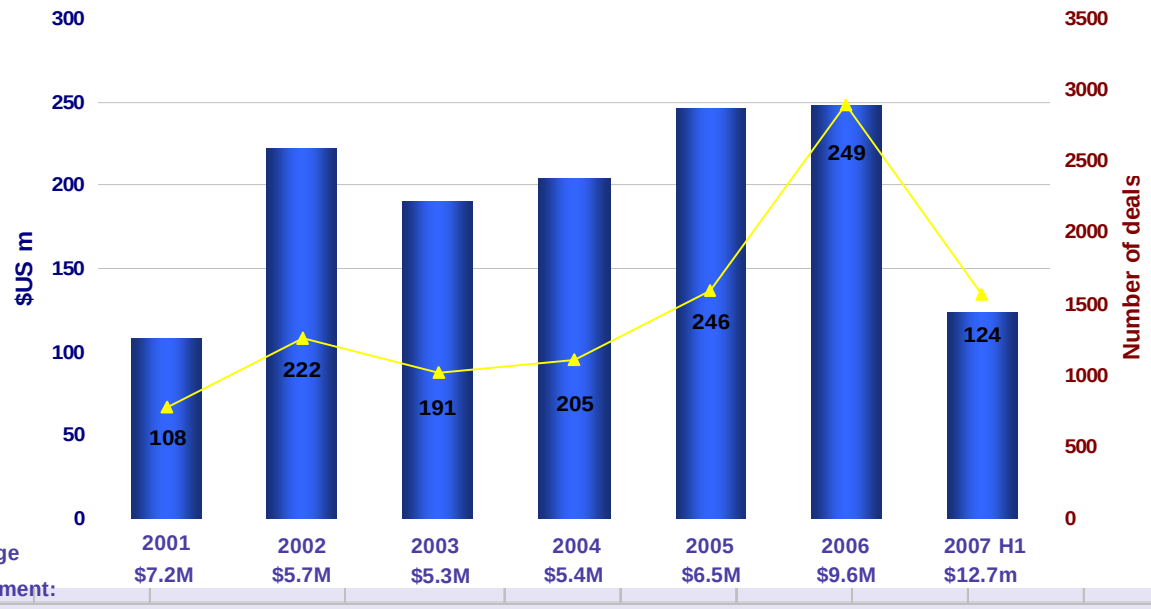
North American Cleantech VC Investment

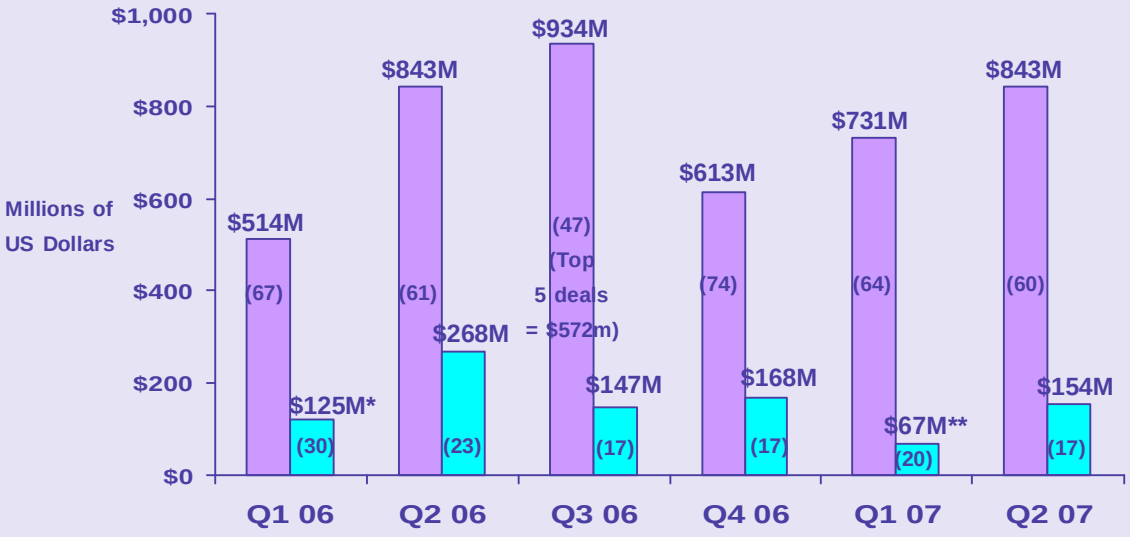
Amount invested and Number of US and Canadian Cleantech Venture deals by Year, 2001- 2007H1



Source: Cleantech Venture Network

North America vs. Europe Cleantech VC investing

European Cleantech VC investments appear to be 15%-25% of the North American total, depending on the quarter



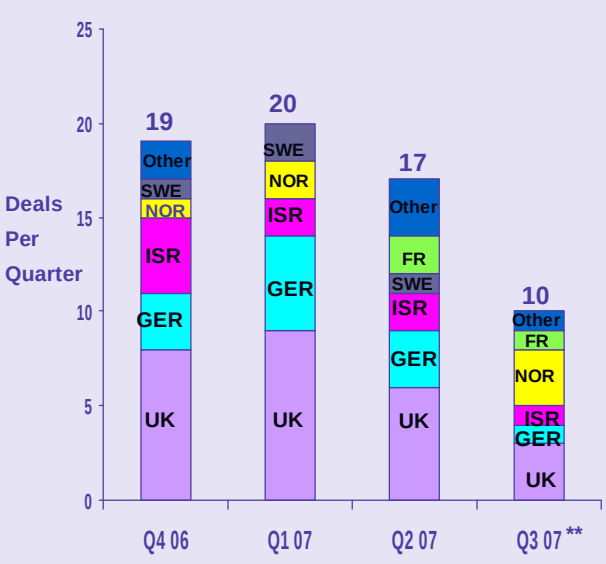
* CVN just began tracking European investments in Q1 2006, so this data set is likely incomplete

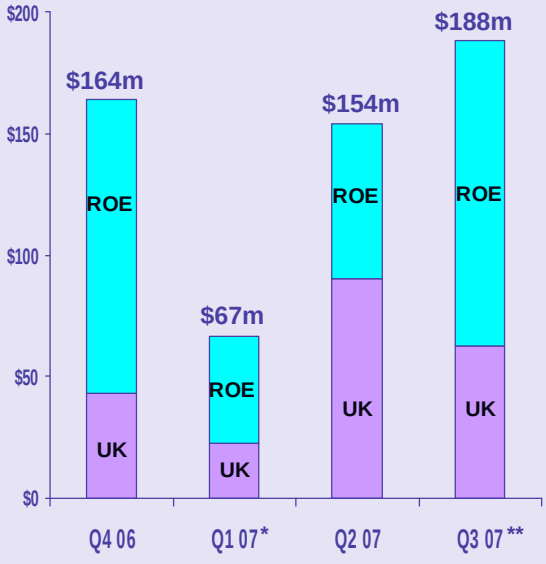
** 8 of 20 European deals in Q1 07 were of undisclosed value

Source: Cleantech Venture Network

UK vs. Europe Cleantech VC investing

The UK leads the European Cleantech VC scene in both number of deals and dollar volume





*** 12 of 20 European deals in Q1 07 were of undisclosed value**

**** Data may be incomplete owing (data still pending from Q3)**

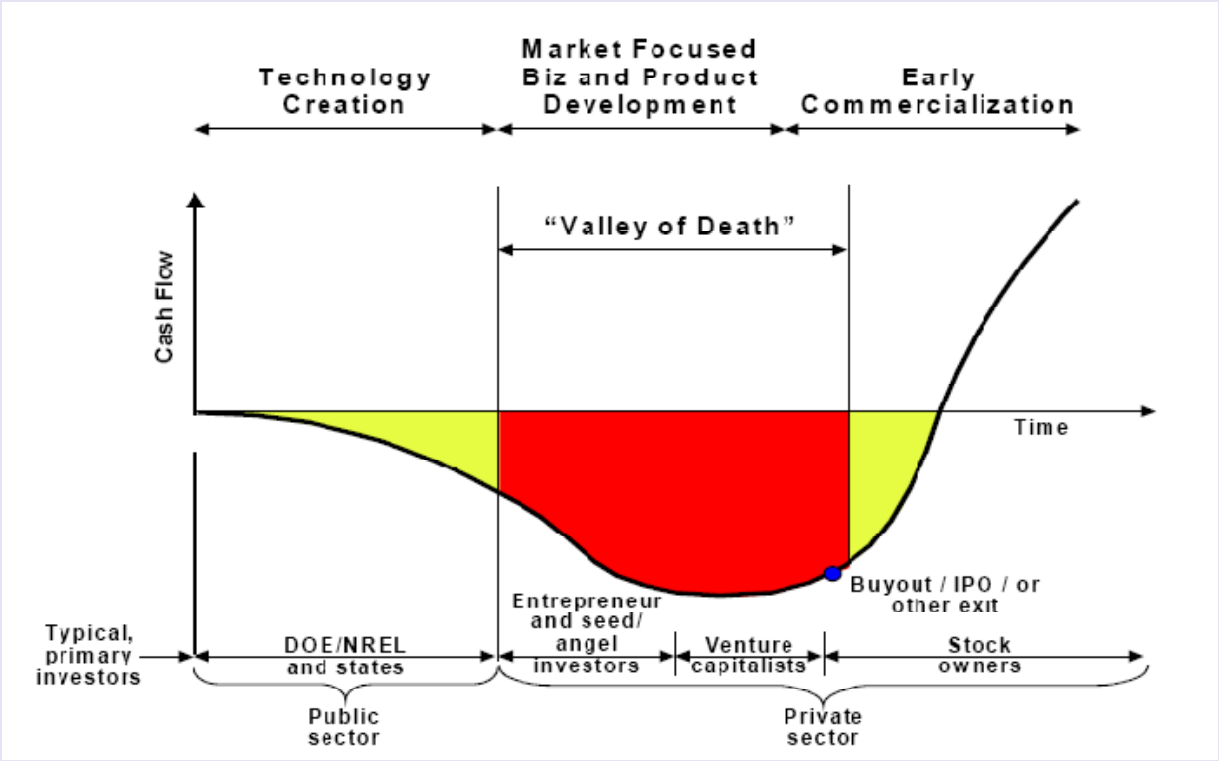
Source: Cleantech Venture Network

Top European Cleantech VC Deals Q1–Q3 07

Company	Sector	Business Description	Amount Invested	Investors	Quarter
Think Global AS	Transport	Electric Car	$60.0m	British Hazel Capital LLP, Canica, Capricorn Investment Group, CG Holding, DFJ Element, RockPort Capital Partners, Wintergreen Advisors	Q3 07
TMO Renewables	Biofuels	Cellulosic ethanol (enzymatic hydrolysis)	$29.9m	Aegon Asset Management, Charles Stanley Securities, City Capital	Q2 07
Solarcentury	Energy Generation	Building-Integrated PV products and installation	$27.3m	Zouk Ventures, Good Energies Inc., Foursome Investments Ltd, Scottish and Southern Energy Plc., VantagePoint Venture Partners, Vantania Holdings ,	Q3 07
Metalysis	Industrial	New metals winning process (FC Cambridge)	$26.5m	3i, Cambridge Capital Group, Chord Capital, Environmental Technologies Fund, QuinetiQ, Seven Spires Investments	Q3 07
SWAY AS	Energy Generation	Floating Wind Turbines	$25.8m	Lyse, Rosenberg Verft, Scatec AS, Statoil	Q3 07

Source: Cleantech Venture Network

Traditional Technology Funding Cycle



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

Technology Commercialization Funnel (Schematic)

Research (government, university, corporate, other)

(X000s)

Independently Commercialized

(Founders, angels, seed, grant)

(500-1000?)

VC candidates

(100)

VC invested (1 in 100 for any 1 VC)

(3)

Successful exit

(1)

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

What makes a technology investable?

- First, need a company!
- Differentiated approach with significant competitive advantages over other technologies (new and established)
  - Parity with fossil fuels is (usually) not enough
- Large, growing marketplace (realized or emerging)
  - >$1B/year revenues
- Clear customer(s) with burning, unmet need and willingness/ability to pay
- Defensible IP position
- Profitable business model
  - Control the flow of value
- Entrepreneurs with vision and ambition, and who know how to work as part of a team

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Major Cleantech Categories (Amadeus take)

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

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- **Semis**
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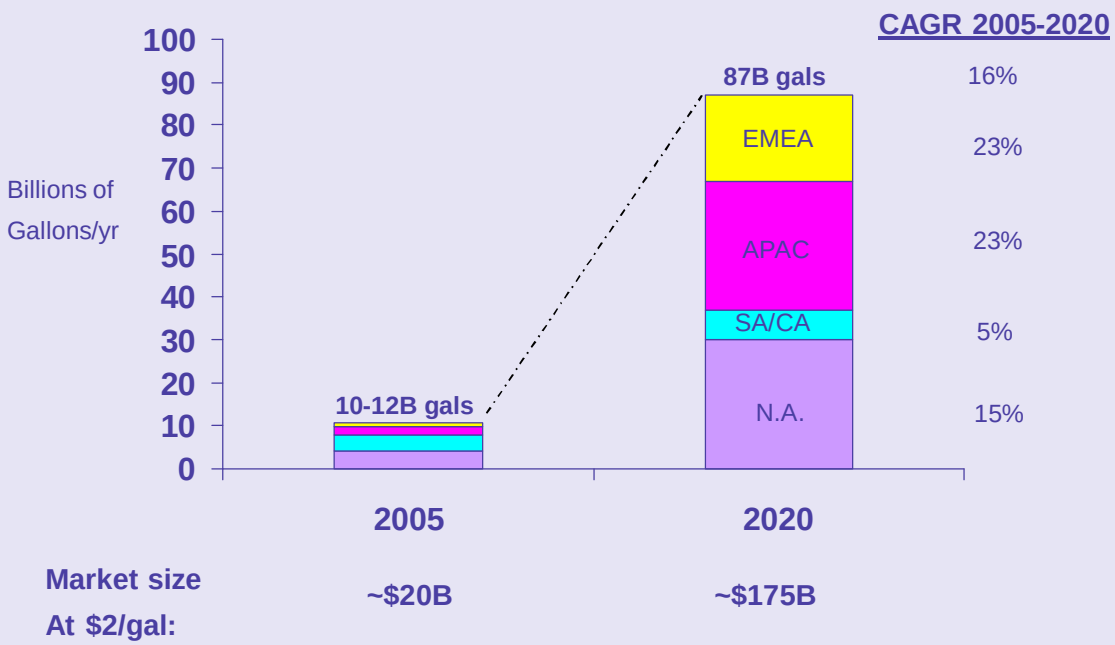
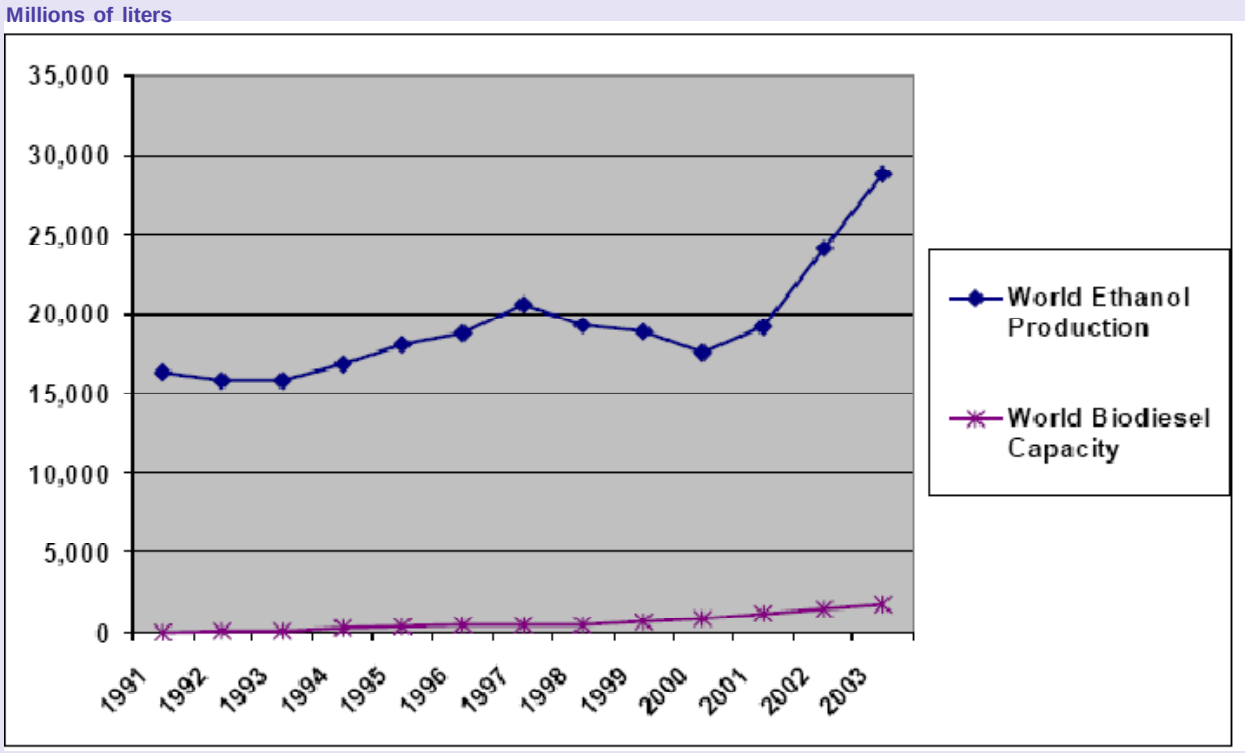
Global Biofuels Growth Forecast



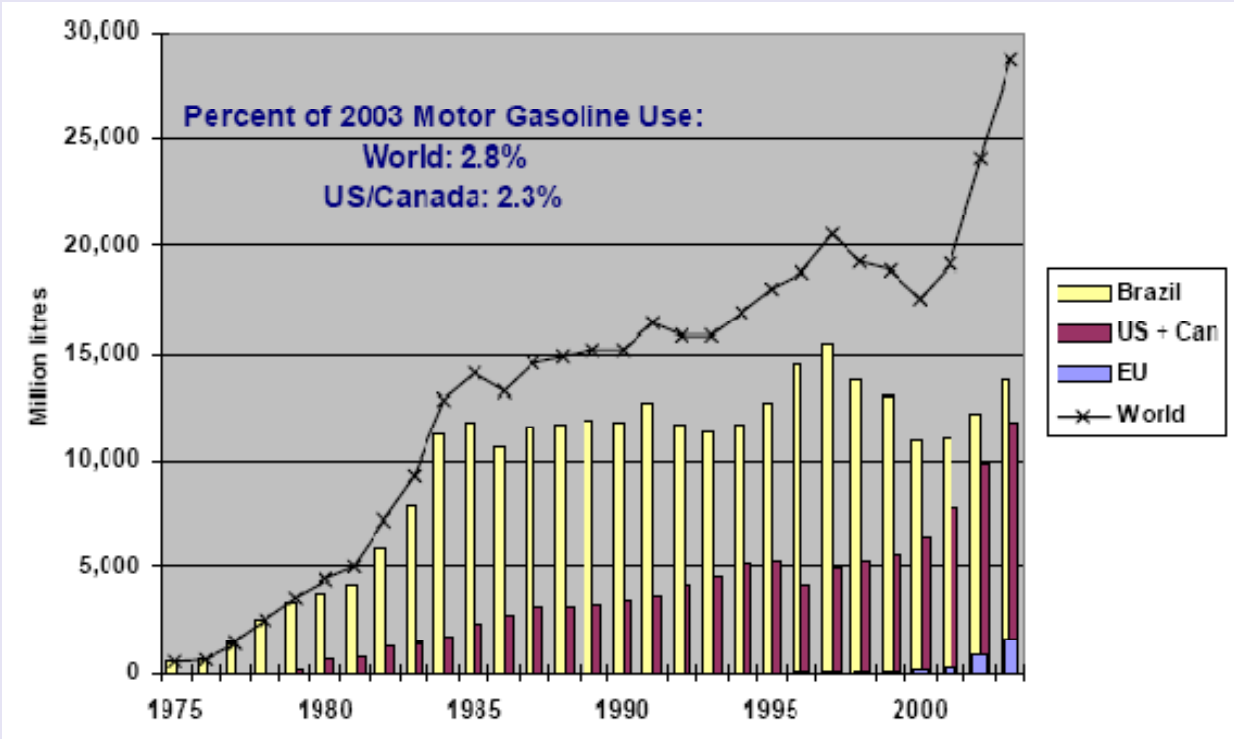
Source: DuPont, JP Morgan. Jefferies;

Ethanol Dominates Global Biofuels Production



Source: F.O. Lichts

Global Ethanol Production

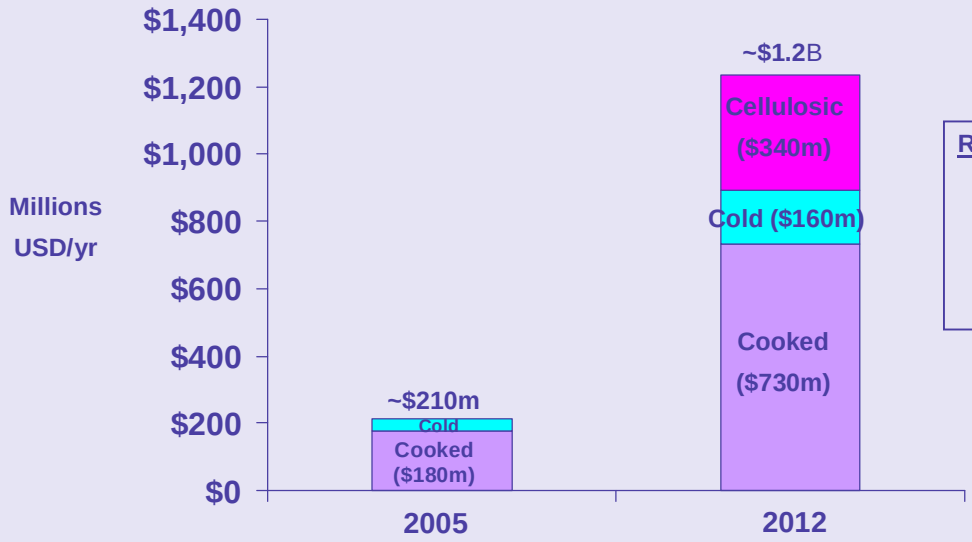


Source: F.O. Lichts

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

Global Biofuels Enzyme Market Potential 2012 (Amadeus Estimate)



Rough 2012 Market Breakdown:
NA 67%
EUR 19%
ROW 14%

	2005	2012
Total Global Ethanol Production:	10B gals	32B gals

Key Assumptions:
- Addressable market = N.A., EUR, 50% of ROW. Excludes biodiesel and cane
- CAGRs 2005-2012: NA 20%, EUR 50%, ROW 50%
- Share by method in 2012: Cooked 80%; Cold 10%; Cellulosic 10%
- Enzyme price/gal = Cooked $.04, Cold $.07, Cellulosic $.15

Source: Amadeus analysis; EIA AEO 2006; BP; JP Morgan, Jefferies; NREL
Note: incldues ADM captive market

Biofuels Investment Opportunities

Principle	Opportunity
• Efficient utilization of waste/cellulosic feedstock (<$2.00/gallon)	• Novel enzymes and thermophiles for conversion of feedstock and fermentation of complex and simple sugars • Gasification?
• Remove/simplify process steps for biofuels conversion	• Combine cellulosic pre-treatment, hydrolysis, and fermentation into two steps (or even one); new reactor designs • Dramatically reduce energy penalty; speed up process; improve yields
• Feedstock optimization	• Non-plant feedstocks (eg algae) • Novel pathways from waste materials or other chemicals
• New fuels	• Butanol; DME; other?
• Other supply chain innovation	• Biofuels branding, distribution, marketing • Vehicle retrofits

'Green Chemistry'

Old Processes		New Processes	
Petroleum feedstocks	• Depletive • Extractive	Biomass feedstocks	• Renewable • Un-used waste
Thermo-chemical catalysis	• Multi-step • Compounding yield loss • High energy penalty	Biological conversion	• Parallel • Naturally high yields • Lower energy penalty
Toxic end-product and by-products	• Transport • Disposal • Recovery • Emissions	Degradable/ designer end products	• Optimize product mix • Optimize eg combustion characteristics

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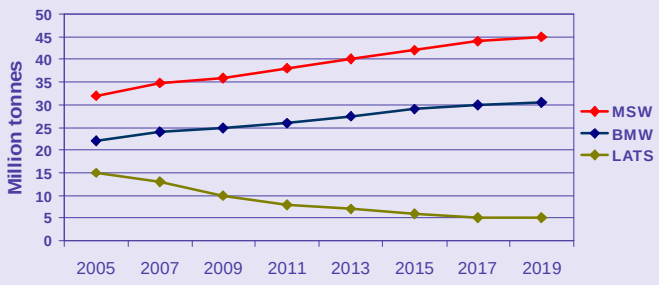
- **Process Control and Simulation**

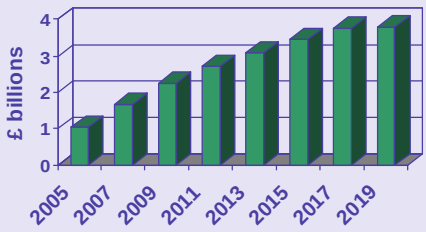
Compelling market drivers

EU Directive creates urgent need to reduce waste going to landfill

UK household waste to 2019



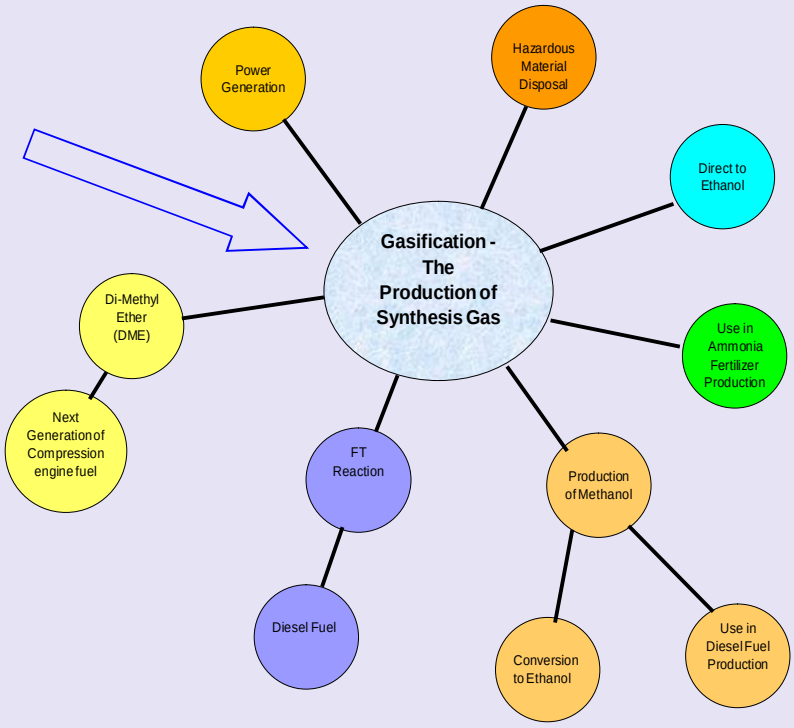
Annual cost of LATS Penalty



LATS targets are designed to enforce a 65% reduction in biodegradable municipal waste (BMW) going to landfill by 2020

Defra (UK) estimates that 1,000 new waste treatment facilities will be needed in the UK just to comply with the EU landfill directive at a cost of £20 bn

Flexibility of Gasification



Huge Market Opportunity

Renewable Power Generation: UK/EU

- Waste gasification can provide 11GW of the 35GW of new capacity required by the UK over the next 10 years:
  - £12 billion annual revenues from tip fees and power sales
  - Would be 400 x 10 MW facilities (addressable market of £5 billion)
- Similar opportunities throughout Europe and US providing localized power islands in manufacturing and public sectors

Biofuels: US, EU, Asia

- US and EU governments are raising mandated targets to 50 billion gallons (5x increase) in next 12 years:
  - £75 billion revenue market
  - £50 billion investment
- Asia/Japan desperately short of transport fuels creating huge growth markets for ethanol, biodiesel and LPG

Biomass/waste co-firing: US, Asia

- Syngas from biomass and waste can be co-fired in coal fired power plants to reduce emissions and increase capacity
- Significant opportunity in US and Asia with both new and legacy plants

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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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Backup

Holy grails

The Goal	Current State of Art
• Solar at $1.00/W installed (or $.10/kWh)	• $6/W installed
• Cellulosic biofuel at $1.50/eeg (cost)	• Cane ethanol @ $1.10eeg; Corn ethanol @ $1.50eeg
• Carbon capture & sequestration @ $30/t	• Sequestration unproven
• Direct coal/carbon fuel cell at $.10/kWh with CO_2 capture	• Lab scale at very low efficiencies
• Residential/SMB energy management device & service with 1 year payback	• N/A (Commercial ESCO)

Why cleantech is different

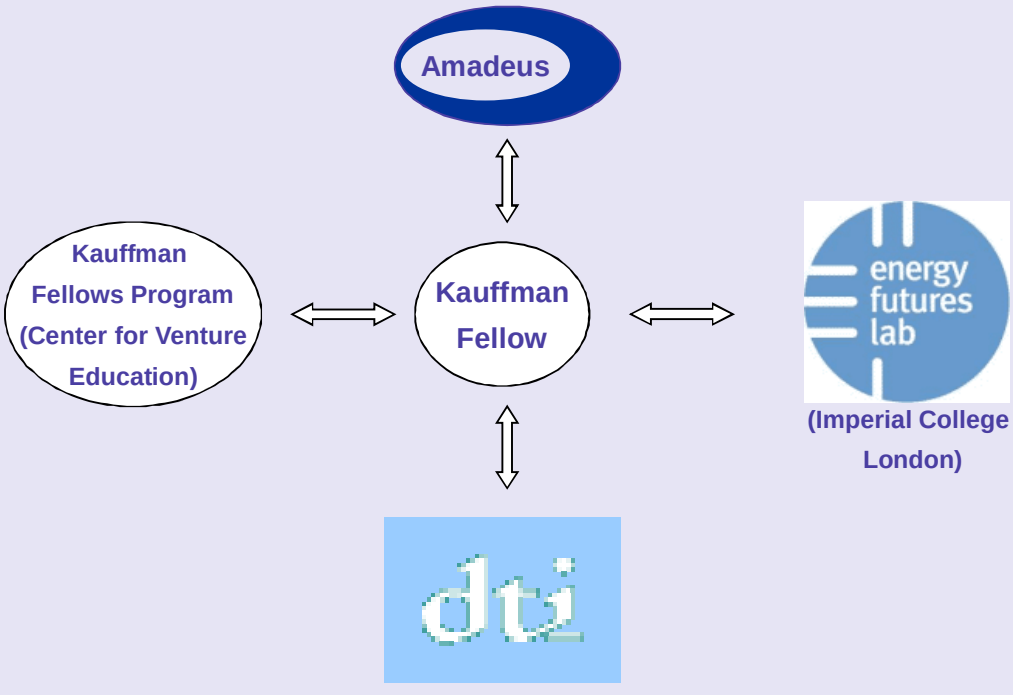
- Looks like biotech
  - Capital intensive
  - Long commercialization times
  - High technology risk
  - heavy regulation
- Looks nothing like biotech (or IT)
  - Commodity end-markets
    - If you can make it, you can usually sell it (quickly)
    - Market price = no rent! = lower GMs
    - Long-term winners determined by cost cost cost
    - Global in outlook
  - Manufacturing businesses = scalability tied to CAPEX
  - Capital intensity is more in D than R (vs biotech)
  - Real estate, project development, supply chain are critical
  - Incumbent infrastructure good for 3-5 decades
  - No Moore's Law = few 10X better/faster/cheaper (more incremental)
  - Regulation is much more fragmented

Top UK Cleantech VC Deals Q4 06 – Q1 07

Company	Sector	Business Description	Amount Invested	Investors	Quarter
TMO Renewables	Biofuels	Cellulosic ethanol (enzymatic hydrolysis)	$29.9m	Aegon Asset Management, Charles Stanley Securities, City Capital	Q2 07
Solarcentury	Energy Generation	Building Integrated PV products and installation	$27.3m	Zouk Ventures, Good Energies Inc., Foursome Investments Ltd, Scottish and Southern Energy Plc., VantagePoint Venture Partners, Vantania Holdings ,	Q3 07
Metalysis	Industrial	New metals winning process (FC Cambridge)	$26.5m	3i, Cambridge Capital Group, Chord Capital, Environmental Technologies Fund, QuinetiQ, Seven Spires Investments	Q3 07
Intelligent Energy	Energy Generation	PEM Fuel Cells	$17.1m	Black River (2 funds), Credit Suisse, Evolution Placements Corporation, Meditor Capital Management	Q2 07
Sterecycle	Recycling	Autoclave systems for MSW	$15.0m	Ailsa3 Ventures	Q4 06

Source: Cleantech Venture Network

KFP/KTP Structure



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’?