Financing the Transition

John E. Parsons
October 31, 2008
MIT Global Change Forum

Problem Statement

- Focus on finance: Transitioning to a low carbon economy will require major investments. Can the financial system handle it?
  - This is not a question about cost, about whether we can afford it. I want to take as given whatever choice is made in weighing the costs and benefits of strict targets.
  - What is special about the problem of financing these investments? Will the current financial system add to the costs? Are there actions that can be taken to smooth the financing of the transition.

- The current financial crisis:
  - Raises obvious questions of its own.
  - Problem at hand in this talk was posed before the current crisis, and will outlive the current crisis.
  - But the current crisis actually helps to highlight the critical issues at hand when we try to prioritize the issues facing us in financing a transition.
  - At the end of the talk, I will return to discuss the current financial crisis and the lessons to be drawn from it.

Setting the Stage:
The IEA's summer news release.

FINANCIAL TIMES

The world needs to spend $45 trillion on green technologies in the next 40 years, or 1.1% of annual global economic output to halve greenhouse gas emissions by 2050.

Nobuo Tanaka, IEA executive director, said the world needed a "technology revolution" to halve greenhouse gas emissions by 2050, which would "completely transform the way we produce and use energy".

June 6, 2008

IEA's Study: How the Results Were Constructed

- The IEA focuses on two different targets for reduced CO2 emissions paths and asks what changed investments in the energy industry could be made to successfully achieve each path. One path involves capping 2050 emissions at the 2005 level. The other path involves capping 2050 emissions at 50% of the 2005 level.
- To achieve these emissions reductions, the IEA evaluates the potential for reductions in energy use, for energy efficiencies, for alternative generating technologies, including renewables and carbon capture and sequestration and alternative automotive fuel sources. It estimates the cost of each alternative: both the cost of deploying the technologies once commercially deployed, as well as the cost of RD&D to bring the technology to commercial readiness.
- For each scenario, meaning each emissions path, the IEA selects a combination of choices that is consistent with the underlying base case assumptions about economic growth, and that achieves the targeted emissions reductions. There is no formal equilibrium analysis.

Energy Technology Perspectives 2008. In support of the G8 Plan of Action. Scenarios & Strategies to 2050.

- Baseline Scenario:
  - Without changes in current policy
  - Emissions 2005=27Gt … 2030=42 Gt … 2050=62 Gt
  - CO2 concentration 2005=385ppm… 2030=455ppm…2050=550ppm
- ACT Scenario:
  - Emissions peak in 2030, fall gradually back to 2005 level by 2050
  - Emissions 2005=27Gt … 2030=34 Gt… 2050=27 Gt
  - CO2 concentration 2005=385ppm… 2030=445ppm…2050=485ppm
- BLUE Scenario:
  - Reduce CO2 emissions by 50% from 2005 levels.
  - Emissions 2005=385ppm… 2030=24 Gt … 2050=14 Gt
  - CO2 concentration 2005=385ppm… 2030=425ppm…2050=445ppm
- Scenario modeling.
  - Technologies are selected, costs are tallied. No equilibrium analysis.

IEA Study Capital Costs

- ACT Scenario… $17 trillion:
  - “Additional investment needs are estimated at USD 17 trillion between now and 2050. This is an average around USD 400 billion per year, roughly equivalent to the gross domestic product of the Netherlands, or 0.4% of global GDP each year between now and 2050.”
- BLUE Scenario … $45 trillion :
  - “Additional investment needs in the BLUE Map scenario are USD 45 trillion over the period up to 2050. … The total is about USD 1.1 trillion per year. This is roughly equivalent to the current GDP of Italy. It represents an average of some 1.1% of global GDP each year from now until 2050.”

Translate into specific investments, electricity sector

Annual global investments…

- 30-35 coal-fired power plants with CCS, 500 MW
- 1-20 gas-fired power plants with CCS, 500 MW
- 24-32 nuclear plants, 1000 MW
- 2 GW hydropower
- 30-100 biomass power plants, 50 MW
- 3,675-17,750 on- and offshore wind turbines, 4 MW
- 50-130 geothermal units, 100 MW
- 115-215 million m2 solar panels
- 45-80 concentrating solar plants, 250 MW

Translate into specific investments, heavy industry

- BLUE Map requires widespread application of CCS at large energy intensive plants
- BLUE Map requires additional investment over the Baseline of USD 2.5 trillion in the upgrading of industrial plant – mainly in the steel, cement and pulp sectors – and for increased deployment of CCS.

Translate into specific investments, energy efficiency

- Energy efficiency in OECD countries has been improving at just below 1% per year in recent times.
- The ACT Map scenario requires sustained global energy efficiency improvements of 1.4% per year.
- The BLUE Map scenario calls for 1.7%.

Translate into specific investments, transportation

- ACT Map: improvements in the efficiency of conventional vehicles and the increased penetration of hybrids. Low-carbon biofuels play a part, principally as a replacement for gasoline to fuel cars.
- BLUE Map: Low-carbon biofuels are expected to play a significant role… Trucks, shipping and air transport are the chief users of biofuels… While electric batteries and hydrogen fuel cells are the mail alternatives for cars…
  - 1 billion electric and fuel cell vehicles need to be on the roads by 2050; costing USD 6,500 more than conventional vehicles in 2050.
- Transport represents the largest single area of investment in the scenarios. Additional investment needs in transport are USD 17 trillion in ACT Map and USD 33 trillion in BLUE Map.

The Questions for the Financial System

- Is the financial system capable of funneling money into the energy system at this scale?
- Are there weaknesses in the financial system that need to be addressed to facilitate the flow of investment needed?
- Are there distortions in the financial system that, unaddressed, would add to the cost of this transformation?

Not the Question

- Costs for the two Scenarios…
  - ACT Scenario assumes marginal abatement cost of $50/t CO2
  - BLUE Scenario assumes $200/t
  - Fully commercialized technology costs. Add on top the cost of RD&D.
  - Yields the $17 and $45 trillion values.
  - Possibly an underestimate.
- Are these costs that we want to incur? Can we afford it?
- The financing question assumes the decision to bear some level of costs and asks whether the channels are available and fully function to get the investment dollars to where they are needed.
  - Private investment channels.
  - Public investment channels.

Are Supplementary Financing Channels Necessary?

- For every need, a program:

> ***"Current financing mechanisms will need to be expanded, and new and innovative facilities will need to be created. International financial organizations are aware of the challenge, but need support from donors to expand programmes, pilot new large-scale financing mechanisms and partner with national or regional programmes to enhance their effectiveness or scale."***
>
> **IEA Energy Technology Perspectives, 2008**

Are These Numbers Big?

- What would be required without a carbon constraint? Let's put the figures into context.
- IEA Reference scenario – between 2005 and 2050…
  - Population increases by 40% or 2.7 billion people to 9.19 billion.
  - Annual GDP triples, increasing by $170 trillion to $227 trillion.
  - Primary energy doubles, going from 478 EJ to 974 EJ.
  - Coal use rises from 121 EJ to 364 EJ.
  - Oil use in 2050 is 70% above the 2005 level.
  - Cumulative downstream energy related investments are $254 trillion
- ACT Scenario's $17 trillion is 7% of this $254 trillion.
- BLUE Scenario's $45 trillion is 18%.
- Carbon isn't the only, and not even the major challenge in financing energy investments.

Are These Numbers Big? (cont.)

- Cumulative global capital investment over this horizon will be approximately $1,340 trillion.
- ACT Scenario's $17 trillion is 1.3% of this.
- BLUE Scenario's $45 trillion is 3.4%.
- If transitioning to a low carbon economy becomes a global economic priority, the issue isn't one of total financing capacity.

One Big Issue: Winners & Losers

- Looking at the aggregate costs in any given scenario hides the critical issues. Behind the aggregate figures are major differences in how certain industries are impacted and what the demands are over time. There are winners and losers. Which scenarios are chosen and how policies are structured determines those winners and losers.
- Unpack the details of the IEA scenarios…
  - Electric power,
  - Transportation,
  - Fuel supplies.

Electricity

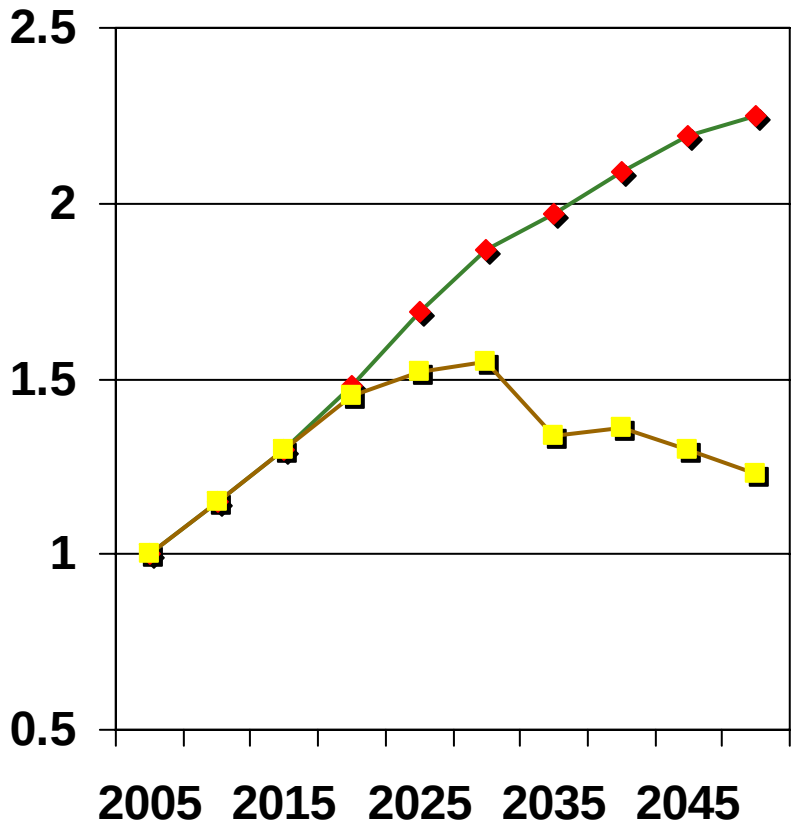
- ACT Scenario:
  - Electricity use is 21% below the Baseline Scenario; investment is $1.1 trillion lower than in the baseline; but generation is growing nevertheless.
  - Generation additions shift to coal with CCS, renewables and nuclear.
- BLUE Scenario:
  - Electricity use is slightly ABOVE the ACT Scenario due to shift of automobiles to electricity and use of heat pumps in buildings which outweigh the further efficiency gains in use elsewhere; especially true in later years.
  - Generation additions include even more coal with CCS, gas with CCS, as well as retrofits of existing units, additional renewables and nuclear ; total investment is $2.9 trillion more than the baseline.
- The interplay between demand growth and shifts across technologies is key.
  - Coal's Valley of Death: the timing of caps and the availability of CCS determines the real dynamics across generation technologies.

Transportation

- Transportation accounts for 78% of the additional investment required in the ACT Scenario and 70% of the additional investment required in the BLUE Scenario.
  - For light duty vehicles, increased investment in the ACT Scenario primarily relates to a shift to more expensive hybrid and plug-in hybrid vehicles, as well as additional improvements to the engine and other features, over and above what would have occurred otherwise;
  - for the BLUE Scenario this includes a shift to all electric vehicles and hydrogen fuel cell vehicles.
  - For the BLUE Scenario this includes major investments for trucks and buses as well as aircraft and shipping.
  - Major change in total investments required for refining, away from petroleum and towards biofuels, as well as GTL and CTL

Fuel Savings

- IEA scenarios result in fuel savings of $34.7 trillion and $50.6 trillion in the ACT and BLUE scenarios, respectively.
  - Discounted at 10%, and netted against investment expenditures…ACT now requires only $0.7 trillion (versus 17) and BLUE only $2.1 trillion (versus 45).
- MIT EPPA model global oil price results:
- Terms of trade impact of a carbon cap on the rents earned from fossil fuels is enormous.



The Question for the Financial System: Reprise

- The major challenge for the financial system has little to do with the scale of the funds required and whether the channels for capital are adequate to the task.
- The real issue is getting the funds to the right place at the right time. It isn't overall capacity, but rather the relative signals being sent, the relative incentives being created.

With that reorientation in place, return to some of the original questions posed:

- Are there weaknesses in the financial system that need to be addressed to facilitate the flow of investment needed? Are there distortions in the financial system that, unaddressed, would add to the cost of this transformation?

What are the specific problems of the financial system?

Inventory:

- 1. No price for carbon.
- 2. Financing R&D: classic public good?
- 3. Financing adaptation: classic public good.
- 4. Inefficient institutions. Old frictions under new stress.
- 5. Immature capital markets in many developing countries.

1. A Price for Carbon

- Investment dollars flow where profits are to be had.
- A price may not be sufficient, but a price is certainly necessary. No price = no profit.
- Efforts to cap the price and hide the cost are a danger.
  - They lower the incentive to make the investment and raise the overall cost of meeting any carbon targets.

1. A Price for Carbon (cont.)

- Predictability? Its overrated.
  - Companies are used to uncertainty.
  - Public policy shouldn't ADD to uncertainty, but neither can it insulate investors from the inherent risks and uncertainty at hand.
  - The inherent uncertainties are enormous. They encompass scientific uncertainties, technological uncertainties, economic uncertainties, not to mention political and diplomatic uncertainties.
  - The price for carbon will naturally and inevitably reflect these uncertainties, just as do prices for all sorts of other commodities, products and services. It is the job of corporate managers to assess these risks and make the appropriate investments.
  - Yes, the "cost of capital" will be higher if the price of carbon is uncertain. But it is appropriately higher.
  - Predictable prices are only good if the policy maker is clairvoyant and able to pick the right price to lock in.

2. Financing R&D

- R&D seems to be the classic case of a public good. Many of the returns are not appropriable. Private business will not adequately fund R&D.
  - The IEA bemoans the declining share of energy R&D in both private and public spending, and uses the two low carbon scenarios and many technology roadmaps to buttress a call for additional public spending: "*…independent studies have suggested that public sector RD&D needs to increase by between two and ten times its current level.*"
- Easier said than done.
  - Track record of government R&D has its own problems.
  - A price for carbon and the ensuing contest among private businesses is an alternative if imperfect R&D incentive structure.

2. Financing R&D (cont.)

- If a global energy industry transformation is truly to be executed, this would seem to be exactly the place where society would benefit from leaving the pathway undefined and letting the huge assortment of private businesses take their different bets on how to get from here to there.
- There are some R&D domains that are indisputably the responsibility of government: CCS is a prime example.
  - Government certification is an essential enabling institution for the private, profit motivated rise of a CCS industry.
  - Experiments at scale are a clear task of government.

3. Financing Adaptation

- Public infrastructure is always a difficult form of investment to finance.
  - The benefits of investment in adaptation measures are spread diffusely across the population and economy.
  - It is difficult to appropriate any of the returns to the investment.
  - It is difficult to craft new fiscal measures that are appropriate to the distributions of the benefits.
  - IMF World Economic Outlook, 2007: “The macroeconomic and fiscal impact of climate change is potentially substantial, and could include the following effects: … deteriorating fiscal positions arising from weakening of traditional tax bases and/or increased expenditure on some aspects of mitigation and adaptation.”
- This is a financing channel that will need strengthening, innovation and cooperative engagement.

4. Improving Market Institutions

- Private investment, responding to prices and the profit motive, is a reasonably good channel for the type of major transformation we are talking about.
- Profit motivated investment requires a supportive institutional framework crafted by appropriate government engagement.
  - Across the globe, in each country, and within various different industries the specific institutional structure within which profit motivated business is making investments differ widely. In certain places, governments have failed to provide the necessary supporting regulations and structures to enable businesses to capture a fair return on useful investments. In other places, governments have imposed troublesome regulations and structures that block the successful functioning of the market. No broad generalizations are possible. There are an infinity of ways that the economic structure could be improved, sometimes by increasing the engagement of government in appropriate supportive activities, oftentimes by decreasing its entanglement. Other times what is needed is just a different type of engagement.

4. Improving Market Institutions (cont.)

- For example, electricity market structure is relevant for action on carbon
  - China: Steinfeld, Lester and Cunningham
  - US: free allowances and regulated utilities; general problem of fuel subsidies.
  - Transmission investments for renewables
- Few of these institutional issues are unique to the carbon problem. They are old weaknesses in the system. The carbon problem just represents a new stress.
- No grand formulas for solving these problems. No magic bullets. No grand financing programs. Have to get down into the trenches and do the work, case by case.

5. Immature capital markets in developing countries

Lessons from the Current Financial Crisis

- The quality and health of the financial markets, *in general*, is more central than the task of developing targeted financing schemes for a low C economy.

The End