Incentives for Renewable Energy to Address Climate Change

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Three Energy Policy Challenge**S**

- Economic Impact – micro and macro
  - cost of energy - fossil fuels are still cheap
  - energy imports affect macroeconomy and trade
- Geopolitics of wealth transfers
  - Beneficiaries of high oil prices are disproportionately autocratic regimes
- Environmental effects
  - particularly greenhouse gases (GhGs)
- The triple dividend from *energy efficiency*

The Arguments for A Government Energy Policy: Market Failures

- Macroeconomic volatility – an oil issue
- Geopolitical impacts – an oil issue
- Environmental externalities
- Failure in market for R, D & D
- NOT the high price of oil or gasoline
- NOT the failure of technology X to thrive

- Pricing externalities is nearly always central to correcting market failures, but not the only tool

Low-Cost Energy Supply Challenge

- If we ignore environmental costs, fossil fuels are likely to be cost effective for a long time
- Renewables will get cheaper, but so will energy capture and storage from fossil fuels
  - Measure full market costs/benefits of renewables
- To have a significant impact in the energy market any alternative has to be scalable
  - Serious challenge for any new technology
  - Scaling up alternatives will drive down price of fossil fuels, greater challenge than recognized

Pricing Greenhouse Gases

- GHG Taxes versus Cap-and-Trade – little difference in practical application
- Taxing "brown" energy versus subsidizing "green" energy
  - Not at all the same – subsidizing green is a "tax" on energy efficiency
  - Subsidizing green through energy bills still isn't right, but it's better than subsidizing from general tax revenue – RPS does this
  - There is no externalities argument for differential subsidies of equally green energy sources

Is "getting prices right" enough to solve environmental externalities?

- Information failures can justify info/labeling and sometimes even standards
- Failure in market for basic science research
- Failure in market for development and deployment
- What about offsetting existing subsidies to brown energy?
  - Retail prices for electricity and natural gas are already well above their production MC
  - Subsidies to oil don't drive down world oil price, just hand cash to producers

Failure in Market for Basic Scientific Knowledge

- Basic scientific knowledge generates huge value, but
  - Difficult to know the value at first
  - Difficult for the inventor to capture the value
  - Intellectual property protection on basic science knowledge is likely to impede further experimentaiton
- So, government subsidizes: NIH, NCI, NSF
- DOE has been no “NIE”, but now ARPA-E

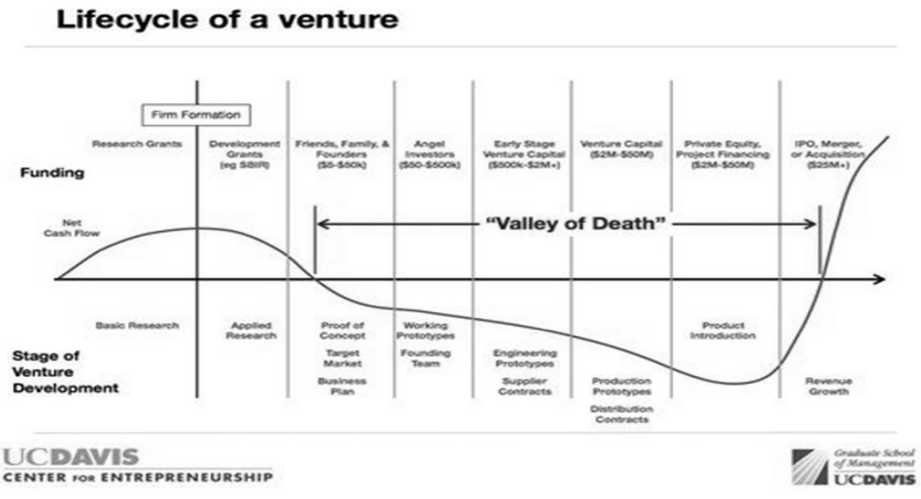
Failure in Development and Deployment

- Learning-by-doing or “experience curve”?
  - Is the learning appropriable by the firm that learns? If so, what’s the market failure?
- Economies of scale
  - Fully appropriable by larger firm
- Network economies
  - Maybe, but scant evidence and could call for subsidies or taxes on new technology
- Empirical work on learning-by-doing and network economies in renewables has not adequately sorted out appropriability, economies of scale or exogenous technological change
- Every market has spillovers. Bigger problem here?

Financial Market Failure: the "valley of death" in development/deployment

- Some good ideas perish in the "valley of death", but so do lots of bad ideas
- Regulatory uncertainty can also create market failures that might incorrectly be blamed on irrational financial markets
  - Option value of waiting until regulatory uncertainty is resolved
- Regulation should not impose *unnecessary uncertainty*, but impact of climate change ***is*** uncertain

The "Valley of Death"



The full market value and cost of residential solar PV (Borenstein, 2008)

- Levelized cost of residential solar PV is now around $0.30/kWh (a bit higher in CA)
  - Less than $0.13 for wind, probably around $0.18 for solar thermal or utility-scale solar PV
  - Coal and Nat Gas less than $0.07/kWh
- But need to adjust for differences
  - Timing and location of power production
  - Intermittency
  - Environmental externalities

Longer-run development and deployment considerations

- Learning-by-doing effects
  - Distinguishing learning from economies of scale and exogenous technological change
  - To whom does the learning spillover?
    - State level? Federal level? Worldwide?
    - Cross-state evidence doesn't support significant state-specific spillovers
- "Valley of death" problem
  - Does this justify special subsidies for solar PV?
- Option value of waiting

The so-called experience curve in solar PV module production (Swanson, 2006)

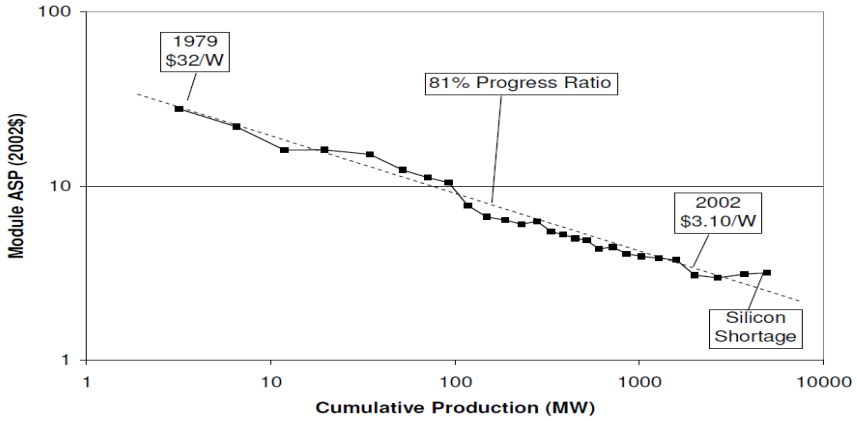


Figure 1: Historical plot of module price showing classic experience curve behavior.

Market failure in science/engineering of solar PV technology

- Probably need fundamental breakthroughs for PV to be cost competitive
  - Potential for huge spillovers
- Incremental improvements in production and deployment engineering likely to have spillovers, though probably limited gains

Conclusion: Renewables Incentives and Climate Change Policy

- Meeting aggressive greenhouse gas reduction goals will not be costless
  - Fossil fuels will still be cheaper for a long while if we do not put a very high price on GhGs
- Minimizing those costs requires realistic policy analysis for the short and long term
- Policy interventions should be carefully grounded in analyzing and correcting market failures
- Success is reducing GHGs, not expanding technology X

GHG controls in the developing world: Another argument for science R&D

- Difficult to push climate change to the top of public policy debate in the US -- even harder in countries with low living standards, disease, famine, political instability
- Ethical case for pressuring them is tough
- Few sticks available, carrots will be needed
- The goal must be to make low-GhG sources the least expensive form of energy
- Strong argument for pushing basic research

Information and Product Standards

- Markets can still fail even if externalities priced "right" due to information failures
- Providing information (eg, labeling) can often address failure without sacrificing choice
- Some information is too complex or costly to process ***compared to*** the cost of losing choice => role for setting standards
  - *Eg, it is illegal to sell food canned in unsanitary conditions*
- Information provision won't solve externalities -- though solutions sometimes overlap
- Standards can address externalities, but likely inefficient absent information failure