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Intended and Unintended Consequences of US Renewable Energy Policies

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USAEE Conference
November 14, 2017

Renewable Energy Policies

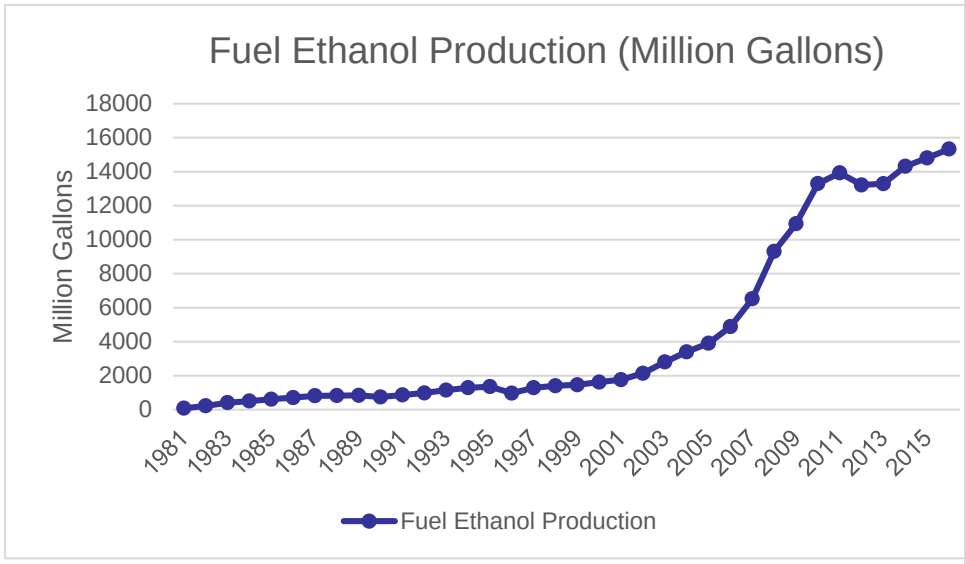
- Most economists would suggest that a carbon tax would be the most efficient way to move away from fossil fuels
- Most governments, including the US, have used a combination of subsidies and mandates to promote renewable energy
- Governments initially used more subsidies, but later moved to mandates, which put the policy cost directly on the consumer instead of on the government budget.

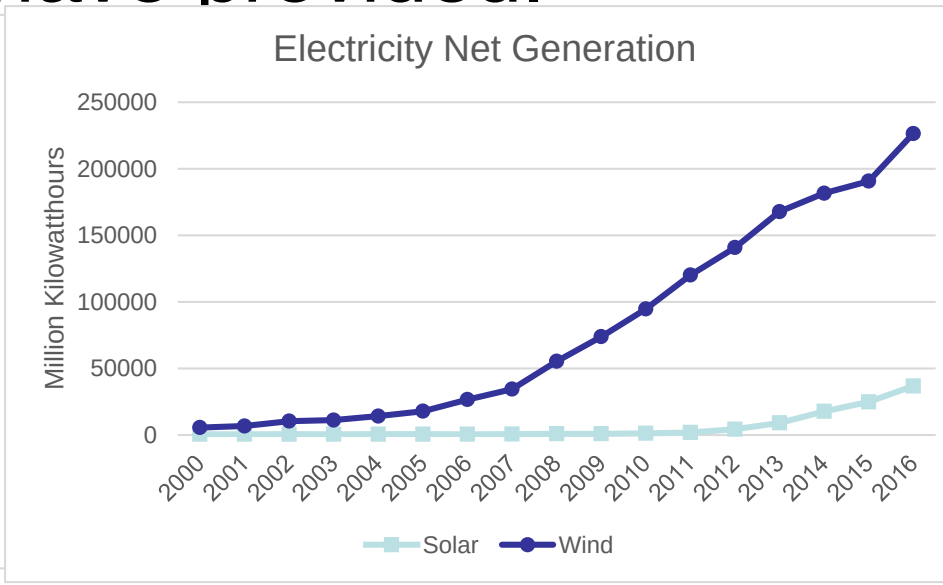
Criteria to Evaluate Policies

1. To what extent did the policies achieve the objective of increasing penetration of the targeted renewable energy?
2. What was the cost of achieving the renewable energy increase, and how does it compare with the SCC or with the carbon price associated with achieving the Paris accord aims?
3. To what extent did the policy reduce US dependence on energy imports?
4. What were the unintended consequences of the policies?

Effectiveness at Increasing Renewable Energy

- For both biofuels and wind and solar electricity, the policies have increased renewable energy far above the levels that markets would have provided.





Policies

- For biofuels, initially subsidies were used, but today the primary policy is the RFS.
  - Did not achieve the cellulosic biofuel target
- For solar there is a 30% federal tax credit
- For wind, there is a production tax credit for each unit of electricity produced.

Biofuels Policy Cost

- We will compare the biofuels costs with the SCC estimated at $40/ton and the cost of achieving COP21 = $160/ton
- $40/ton = $0.19/gal gasoline or $0.27/gal biodiesel
  - Corn ethanol reduces emissions 25%, so the value is about $0.05/gal
  - Biodiesel reduces emissions about 60%, so the value is about $0.16/gal

Biofuels Policy Cost

- One estimate of the policy cost is the RIN values (as of July 2017)
  - $0.67 for corn ethanol
  - $0.92 for biodiesel
- In both cases, the SCC value of emission reduction is much less than the cost.
- RIN prices are also higher than the COP21 value on emission reductions (0.19 and 0.64)

CARB-LCFS Policy Cost

- LCFS quite different from RFS
- RFS is a threshold policy
- A corn ethanol emission reduction credit today translates to about $0.30/gal gasoline equivalent, which is more than the SCC
- The credit price would be expected to increase as the LCFS becomes more stringent.

Solar and Wind Subsidy Costs

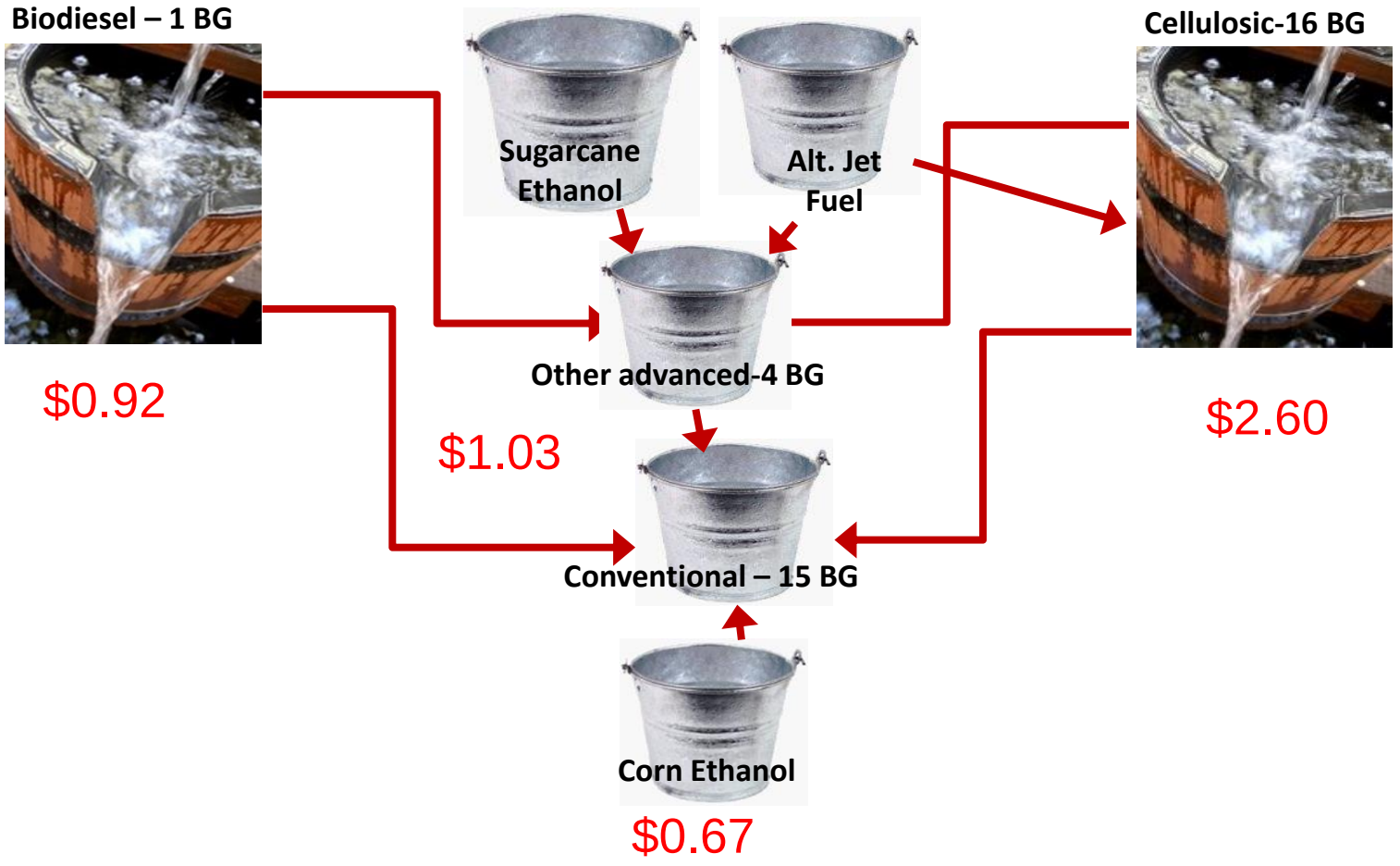
- We estimate the carbon price equivalent for wind and solar subsidies are $32/ton and $79/ton.
  - Wind subsidy is less than SCC
  - Both are less than the Paris accord carbon cost
  - These costs do not include any needed “capacity cost” due to interruptible power

Impact on Energy Imports

- Oil import share under 50%
  - Shale oil
  - Great recession
  - Increased fuel economy
  - Biofuels
- Renewable electricity subsidies have not reduced energy imports as they have largely displaced domestic coal.

Implementation Issues

- Blend wall – had gasoline consumption continued to grow at its historic rate (1.3%) after 2007, consumption would have been over 150 bil. gal. in 2014, so no blend wall.
  - Because of the great recession and CAFE, it did not
- Another issue is the nesting structure
  - RIN price for each biofuel type reflects its relative scarcity with respect to the mandate and the production cost difference with fossil fuel


Biodiesel – 1 BG
$0.92
Sugarcane Ethanol
Alt. Jet Fuel
Other advanced-4 BG
$1.03
Cellulosic-16 BG
$2.60
Conventional – 15 BG
Corn Ethanol
$0.67

Other Implementation Issues

- For cellulosics, obligated parties can buy a credit and an advanced RIN instead of blending the biofuel
  - 2016 Credit ($1.33) +D5 ($1.03) – D6 ($0.67) = $1.69 < D3 rin ($2.60)
- Point of obligation – currently refiners and importers
  - Merchant refiners would like to move it downstream
  - Points of obligation would increase from 150 to well over 1000.

Renewable Electricity

- Net metering has become a contentious issue
  - Imposes cost on other customers
  - Net metering impact is different if the state has peak period pricing
- As penetration increases, utilities have “capacity cost” due to interruptible nature of renewable electricity

Renewable Energy Issues at High Levels of Penetration

- Forest carbon sequestration is very efficient at low levels
- At high levels of adoption, it can lead to substantial increases in forest cover, drop in cropland, and increased food costs.

Renewable Energy Issues at High Levels of Penetration

- For biofuels, most studies have estimated relatively low food price impacts at current levels of penetration.
- However, Reilly and Paltsev estimated impacts for a 55% penetration level.
  - US switches from large ag exporter to net importer
  - Commodity and food prices increase

Renewable Energy Issues at High Levels of Penetration

- For renewable electricity, the capacity cost issue looms large at high penetration
- Gowrisankaran finds that with 20% solar penetration the total intermittency cost is $46/Mwh. The cost increases with penetration.
- One possible solution is storage, but today all the storage options are very expensive.
- Another solution is smart grids.

Three Important Conclusions

- Policy makers have a preference for regulation as opposed to pricing carbon.
  - Buchanan and Tullock in a classic public choice paper argue that in some circumstances it may be in the interests of those being regulated to have regulations instead of taxes.
  - Friedman covered taxes versus regulation in the context of WW II
  - Consumers may favor regulation on equity grounds

Three Important Conclusions

- There is a huge difference in impacts of renewable energy at low levels versus high penetration
  - Reasons differ – for electricity, it is the interruptible nature of renewables such that capacity cost increases with penetration
  - For biofuels and FCS, ultimately land is the limiting resource, and as we push limits, food prices can increase substantially

Three Important Conclusions

- It is much easier to quantify the costs of renewable energy policies than the benefits.
  - Benefits of GHG reduction include avoided crop yield losses, avoided infrastructure damage, avoided health costs, and many others.
  - These losses are real but hard to quantify.

Thanks very much!

Questions and comments.