A Carbon Price for Colorado

What might work, what doesn’t?
How much can it do?
How would it work?

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65 Million Years of Climate Change
Our Eocene Heritage

“Ida” lived 47 million years ago.
This is a dumb plan!
Talk Outline

• Carbon pricing is an indirect, market-reliant policy. Alone it can only work well if markets are efficient, and price signal is substantial.
• Markets not efficient, price signal likely small.
• “Revenue Neutral” carbon pricing is a dangerous distraction.
• What we spend revenue on is very important.
  – Profitable energy efficiency (EE) financing
  – Robust and stable renewable energy market
• Another kind of revenue neutrality is possible, in which carbon is priced, and revenues invested to reduce energy use, stabilize long-term prices.
Markets vs. Regulation

• False dichotomy: all markets regulated.
  – But by whom? And to what ends?

• Pricing carbon is an indirect policy:
  – Does not directly pursue desired outcomes.
  – Presumes markets are efficient.

Is this presumption true?
Efficient Energy Markets?

Abatement cost
€ per tCO₂e

- Lighting – switch incandescent to LED (residential)
- Appliances electronics
- Motor systems efficiency
- 1st generation biofuels
- Cars full hybrid
- Reduced slash and burn agriculture conversion
- Reduced pastureland conversion
- Grassland management
- Organic soils restoration
- Gas plant CCS retrofit
- Iron and steel CCS new build
- Coal CCS new build
- Coal CCS retrofit

Abatement potential
GtCO₂e per year

- Geothermal
- Rice management
- Small hydro
- Waste recycling
- Efficiency improvements other industry
- Landfill gas electricity generation
- Clinker substitution by fly ash
- Building efficiency new build
- Insulation retrofit (residential)
- Tillage and residue management
- Cropland nutrient management
- Cars plug-in hybrid
- Retrofit residential HVAC
- 2nd generation biofuels
- Appliances residential

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Efficiency: ROI vs. Risk

Efficiency Investment Risks and Returns

- Energy Efficiency
- Small Company Stocks
- Common Stocks
- Long-term Corp Bonds
- U.S. T-Bills

Source: Vanguard Group for stocks and bonds. ACEEE estimates adapted from the U.S. EPA data for energy efficiency.
Energy Inefficiencies

- Split Incentives
- Imperfect Information
- Corporate Income Tax Code
- Sunk Costs
- Access to Capital (both RE and EE)
- Poor utility incentives
- Externalized Costs
Dirty Details

• Pricing carbon relies on the market.
• Energy markets are often broken.
• For pricing to work, markets must be fixed.
• Thousands of laws and regulations
• Often local jurisdictions.

• Challenging, but **vital to any market-based solution.**
How big a price signal?

Even with efficient markets, what carbon price is required to transform the economy?
Carbon Price Sensitivity

• Marginal % increase in a fuel’s price due to a small fixed carbon price, e.g. $1/ton.
• Measures the cost of a fuel relative to its carbon content.
• Measure of potential price signal clarity…
• Compare to: price volatility, price of fuel
• $1/ton = $0.01/gal, $0.001/kWh, $0.05/Mcf
10yr Volatility Equivalent Carbon Price

$298

CO2 Price [$/ton]

Petrol

NatGas Fuel

Coal

$88

$9
What does it mean for coal?

• By far the clearest price signal is to coal.
• Coal also a significant emissions source.
• Even a low carbon price on electricity generation fuels can change the market.
• **However…**
  – Utility must eat fuel costs, and/or
  – Allow new generation to compete w/ existing resources
And for other fuels?

• For petroleum and natural gas 10yr volatility is comparable to $100-$300/ton of CO2 emitted.

• At modest carbon prices (< $50/ton) signal is unlikely to restructure the economy unless we do a very good job of fixing market failures.

• Giant caveat: fugitive methane!
Policy Lever vs. Funding Mechanism

• Another way to think about carbon price…
• Revenue mechanism to fund mitigation.
• Easy to measure effects.
• Can directly address policy goals.
• Perfect pricing much less important.
  – Different prices in different sectors
  – Much good to be done even at low prices
  – Much more political flexibility
The Siren Call of Revenue Neutrality

• Some proposals are very regressive.
  – E.g. displacing income taxes (corp or indiv)
• Makes carbon pricing *all* market.
• Even more important to fix market failures!
• Recognize that it is a large concession.
• How much political support does it buy?
• Is it actually useful, budget-wise?
Tax Magnitudes

- US CO2: ~7 Gt/yr
- US Tax: $2,100B/yr
  - Indiv. Inc.: $900B/yr
  - Payroll: $865B/yr
  - 2013 Deficit: $650B
  - Corp Inc.: $200B/yr
- $30/ton for Corp.
- $130/ton for Indiv.
- $300/ton for all.
- $90/ton for Deficit
Carbon Prices Globally

• **BC, Canada**: $30 (tax displacement)
• **Finland**: $30 (general fund, tax displ.)
• **Norway**: $16-$62 (general fund)
• **Sweden**: $23-104 (general fund)
• **Denmark**: $16 (dividend, mitigation)
• **Netherlands**: $20 (tax disp., mitigation)
• **Boulder**: $0.25-$5 (mitigation)
Fee/Tax vs. Cap-n-Trade

- Different pricing mechanisms, doing different things.
- Can be mutually supporting
- Price floor (fee/tax) allows long term planning around minimum price.
- Cap defines emission reduction pathway.
- Trading makes it (potentially) efficient.
Carbon taxes v. EU ETS

Source: Bloomberg

A carbon tax alternative

EU ETS futures prices

4th October 2012

Professor Dieter Helm
What could CO do @ $25/ton?

• $25/ton on electricity fuels = $1B/yr
• EE @ $30/MWh saved = 33 TWh/yr
  – Equal to all our coal-fired electricity
• Wind @ $60/MWh = 17 TWh/yr
  – Half our coal-fired electricity.
• At what personal cost?
  – $1B/yr statewide = $200/yr per person.
  – One pitcher at Mountain Sun each month.
“Revenue Neutral” Redux

Abatement cost
€ per tCO₂e

[Diagram showing various abatement costs and potential energy sources with their abatement potential in GtCO₂e per year.]

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PV EXPERIENCE CURVE, 1976-2012
2012 $/W

PV MODULE PRICES HAVE FALLEN 80% SINCE 2008
20% IN 2012 ALONE

Note: Prices inflation indexed to US PPI.

Source: Paul Maycock, Bloomberg New Energy Finance
AVERAGE LEVELISED COST OF ONSHORE WIND, 1984-2012 (€/MWH)

WIND TURBINE PRICES HAVE FALLEN 29% SINCE 2008

Note: Learning curve (blue line) is least square regression: $R^2 = 0.88$ and 14% learning rate.

Source: Bloomberg New Energy Finance, ExTool
Energy Revenue Neutrality

• Efficiency is a local job creator.
  – 1% of Germany employed in building EE

• Distributed Renewables funded w/ FiT keep energy dollars much more local, de-centralize control.
  – Majority of DG in Germany is owned by individuals, cities, co-ops, small biz, etc.

• Spent well, carbon revenues will save us both energy and money and stabilize energy costs long-term.
Policy Draft

• Price carbon from coal/natural gas in CO.
• Start at $5/ton, rise from there.
• Change fuel pass-through and existing vs. new resource competition at PUC.
• Get on top of fugitive methane emissions.
• Use carbon revenues to:
  – Fund EE finance (like KfW)
  – Fund RE generation via FiT/standard offer.
• Get to work fixing local energy market failures.
Further Reading

- Smart Power (Peter Fox-Penner, 2010): http://www.smartpowerbook.com/
Media Credits

- PRB Coal Trains: http://flic.kr/photos/kimon/3910811017/
- Brisbane Flooding: http://flic.kr/photos/erikveland/5348202203/
- Carbon Zero by Alex Steffen: http://www.amazon.com/Carbon-Zero-Imagining-Cities-ebook/dp/B00AEWHU8E
- Carbon Tax vs. EU ETS by Prof. Dieter Helm: http://www.dieterhelm.co.uk/sites/default/files/Bruegel041012.pdf