Sir Karl Raimund Popper, “the main task of the social sciences is to trace the unintended consequences of intentional human actions.”

Anmerkungen zur EU-Klimapolitik (Regulierungen) nach Paris 2015

Franz Wirl
Universität Wien

Energiemärkte im Wandel – Investitions- und Innovationsanreize und die Umsetzung der Klimaziele von Paris“
WU, 8. November 2016

Inhalt

- Der Klimavertrag von Paris
- Ökonomische Aspekte des Klimaproblems
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  Bindungsunfähigkeit der Politik
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- Lösungsstrategien im Großen
  Effizienz
  Erneuerbare Energie
- Politikversagen bei den Strategien
  Zertifikate – CO2, erneuerbar, weisse
- **Wichtige Klarstellung Energie, nicht Strom (<20% TFEC global)**

- Zum Aufwärmen: Stärkere Reduktion der CO2 Emissionen in den USA oder EU?

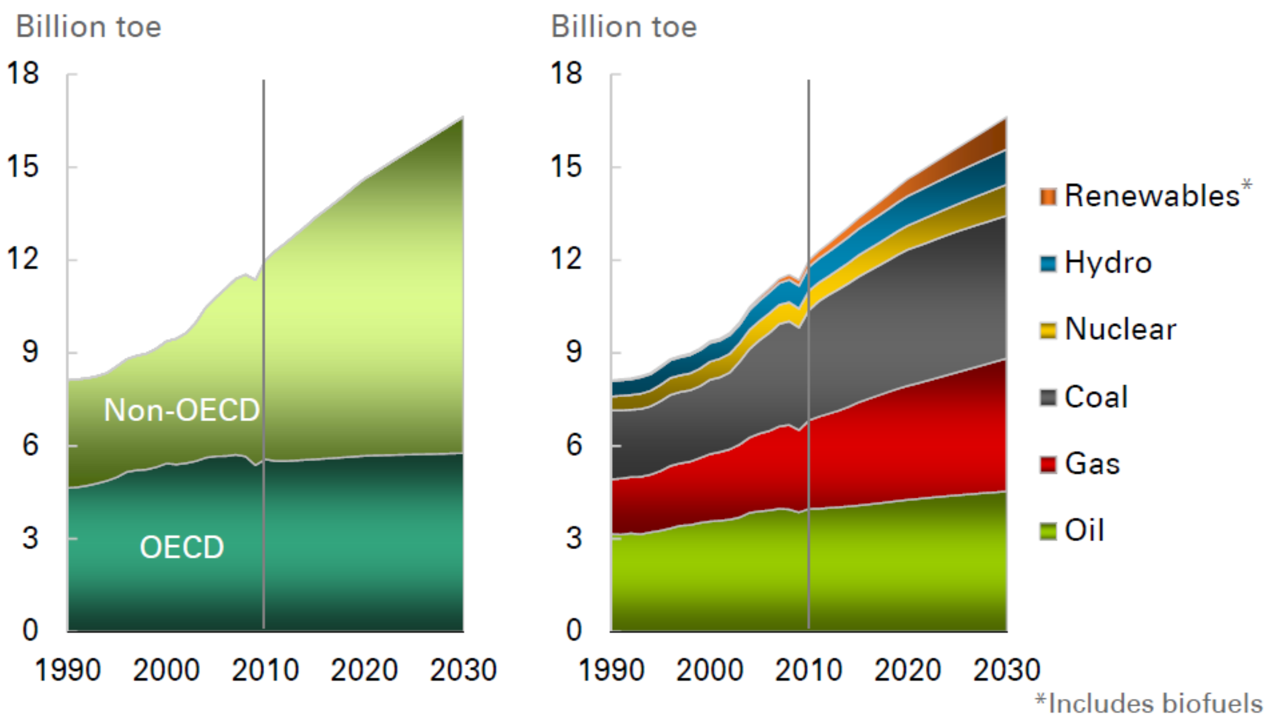
Eckpunkte des Klimavertrags von Paris 2015

United Nations Framework Convention on Climate Change, 21st Conference of the Parties (COP)

- Beginn mit 2020
- Vorgabe eines Klimaziels (*open loop*), < 1.5^{o} C
  => Null Treibhausgasemissionen weltweit in der zweiten Hälfte des 21. Jhdt.
- Die Industrienationen verpflichten sich, den ärmeren Staaten 100 Mrd $ pro Jahr für Klimaschutz und Anpassung an den Klimawandel zu zahlen. Auch Verluste und Schäden, die viele kleinere Länder durch die Klimaphänomene wie Überschwemmungen, Stürme oder Dürre bereits erlitten haben, sollen teilweise ersetzt werden.
- Keine verbindlichen Reduktion anstatt dessen **freiwillige Verpflichtungen** (*nationally determined contributions*). Wie wasserdicht die sind, lässt sich beispielhaft am Austritt von Kanada und Australien aus dem Kyoto-Protokoll erahnen.
- Keine Sanktionen

Einige Fakten

- Energiebedarfswachstum außerhalb der OECD und negativ für EU



- **Energiearmut**: 1.3 10^9 ohne Strom, nur 32% haben Strom in Sub-Sahara
- **Elektrizität < 20% des Gesamtendenergieverbrauches**

Ökonomische Aspekte des Klimaproblems

- Tragödie der Allmende: individuelle und österreichweite Initiativen sind sinnlos.
- Dies wird dadurch verschärft, dass die durch den CO2-Ausstoss verursachte Erderwärmung ein reines **Bestandsproblem** ist.
- Momentane Emissionen und damit auch deren Reduktionen tragen immer nur einen Bruchteil zur bestehenden Bestandsdynamik bei (z.B. Kyoto).
- Stabile Koalitionen sind klein ($n \leq 3$).
- Strategisches Warten mit Initiativen bei zukünftigen Beschränkungen.
- Dazu kommt, dass die Schwarzfahrerproblematik nicht nur die Emissionen sondern auch die Forschungsinvestitionen betrifft.
- Irreversibel, langfristig, unsicher und global © Wagner&Weitzman.

Model

Stock of pollution
global warming

# of players

$$\dot{X}(t) = \sum_{i=1}^{N} x_i(t) - \delta X(t), \quad X(0) = X_0 \text{ given.}$$

Benefit from emissions

$$u(x) = x - \frac{1}{2}x^2$$

External costs (*global warming*)

$$C = \frac{c}{2}X^2$$

Social optimum
($x(t) = x_i(t)$)

$$W(X(0)) = \max_{\{x(t) \geq 0\}} \int_0^{\infty} e^{-rt} u(x(t)) - C(X(t))\, dt$$

Brown consumers

$$V_i(X(0)) = \max_{\{x_i(t) \geq 0\}} \int_0^{\infty} e^{-rt} \left[u(x_i(t)) - C(X(t))\right] dt, \; i = 1, ..., N$$

Lösungen zur Tragödie der Allmende

- Intrinsische Motivation & freiwillige Aktionen
  sind (Hoel) oder können (Wirl, Kantsche Präferenzen) kontraproduktiv sein,
  Hoel nach Helm–Wirl „unilateral action by player 1 (the North) worsens its disagreement point and, conversely, improves the bargaining position of the other player (the South). Consequently, the South can capture a larger share of the bargaining rent. In the absence of transfer payments, this is implemented by higher abatement of the North and less abatement of the South. If marginal abatement cost of the North are relatively high, then its additional abatement cannot compensate the lower abatement of the South and aggregate emissions rise due to unilateral action."
- Selbst EU-weite Maßnahmen sind problematisch und kontraproduktiv wegen
  leakage (gilt auch fürs Abholzen, 50% im Falle der US nach Murray aus Harstad)
  und des **grünen Paradoxons** (H.W. Sinn):
  Einseitige Reduktion des Verbrauchs (z.B. durch den "Westen") reduziert die internationalen Preise, was den Verbrauch in den anderen Ländern anheizt. Dies kann den transienten CO_2-Ausstoß erhöhen (Sinns grünes Paradoxon), was möglicherwese einen großen und irreversiblen Eintrag an Treibhausgasen (CH_4 gebunden in Permafrostböden) zur Folge hat.
- Bestrafung von Schwarzfahrern durch Ausschluss aus der WTO (Barrett, Nordhaus) um hohe Teilnahme sicherzustellen
  (wie das mit der Skepsis der Grünen gegen Freihandel kompatibel ist, …)
- Marco Battaglini und Bard Harstad: linearer Schaden &R&D => IEA möglich bei unvollständigen Verträgen.
- Es ist ohnedies falsch auf Moral zu setzen (Moses).

Green consumers

Social optimum

$$\max_{\{x_i(t)\geq 0\}} \int_0^\infty e^{-rt}\left[u(x_i(t)) - P\left(x_i(t), x^*(t)\right) - C\left(X(t)\right)\right]$$

$$P\left(x_i, x^*\right) = \frac{p}{2}\left(x_i - x^*\right)^2$$

Green consumers feel guilt if their consumption deviates from what it should be (similar to Brekke, Kvernedokk and Nyborg (2003)).

Motivation for this setup:

- Kantian (but White 2004 rejects this tradeoff as Kantian).
- To exclude subjective and psychological aspects in establishing the norm itself.

Polito-ökonomische Hürden

- **Bindungsunfähigkeit der Politik** (Kydland & Prescott)
  Theoretisches Bsp. Ankündigung einer hohen Energiesteuer
  Erdgas- und Elektroauto
  Historische Bsp.: USA – Ölpreisregulierung, Anthrax, Gasexport?,
  Price Caps generell (im Besonderen Littlechild gefolgt von Blair), Spanien – PV
  Maastricht, Griechenland, Flüchtlingskrise 2015

  Starkes Innovationshemmnis, denn > 7 Milliarden Menschen, > 200 Regierungen werden KEINEM Innovator Monopolrenten erlauben und selbst versprochene Renten (implizit über Umweltabgaben) ex post wegnehmen.

- Private Interessen der Politiker => Politik- versus Marktversagen
  Bsp.: Steuern versus Zertifikate, Flexsteuervorschlag (vgl. auch 2008!)

- Ignoranz von Anreizproblemen und dadurch höchst ineffiziente Maßnahmen (Bsp. folgen).

Modell zu Innovation und Umweltabgaben als Anreiz

Consumers – Demand
carbon input y - competitive,
renewable x, monopolistic

$$U(q) = q - \frac{q^2}{2}. \qquad q = x + y$$

$$y(\tau, x) = 1 - \tau - x$$

Damage

$$D = \frac{1}{2}\gamma y^2$$

Government
reimburses tax revenues

$$S = CS + R + \pi - D$$

Renewable industry – entrant

$$\pi := \tau x - cu - \frac{k}{2}u^2$$

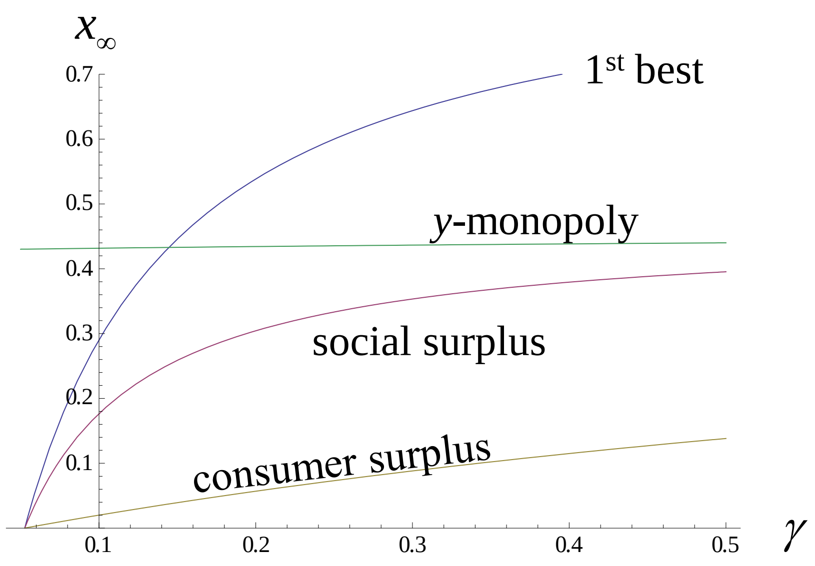
$$V(x_0) = \max_u \int_0^\infty e^{-rt}\left[\tau(t)\,x(t) - cu(t) - \frac{k}{2}u^2(t)\right] dt$$

$$\dot{x} = u - \delta x, \;\; x(0) = x_0$$

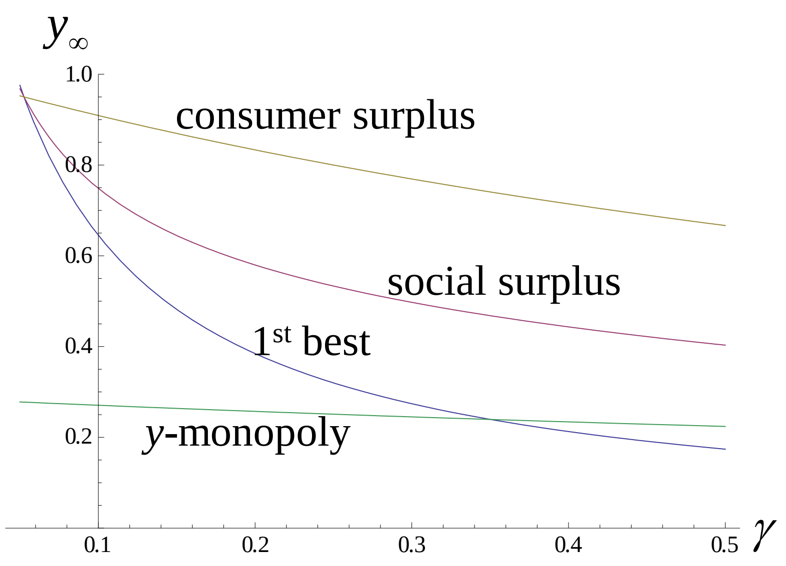
Comparing steady states versus external costs (γ)

$r = 0.05$, $c = 0.5$, $k = 10$, $\delta = 0.05$.

Steady state, clean technology



Steady state, dirty technology



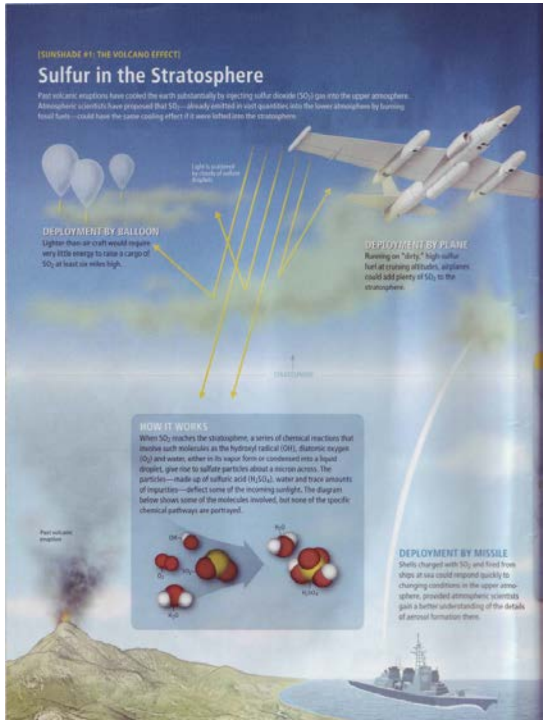
Ein *y*-Monopol ist ‚the conservationist‘s best friend‘

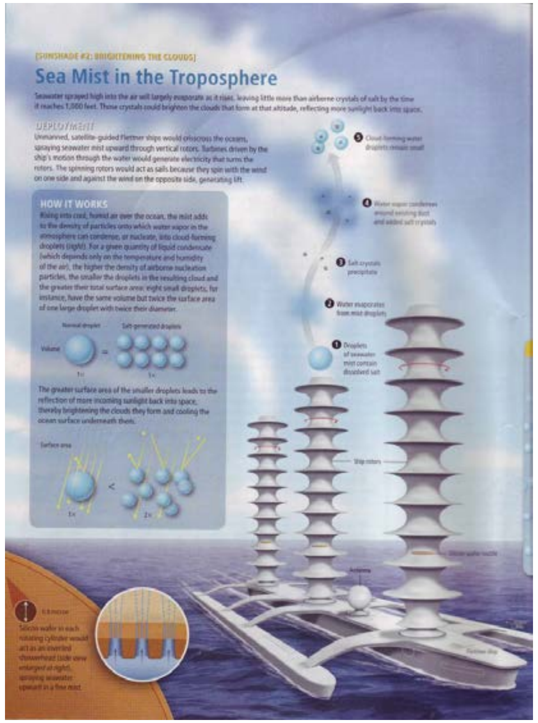
Zusammenfassung dieser ökonomischen Probleme

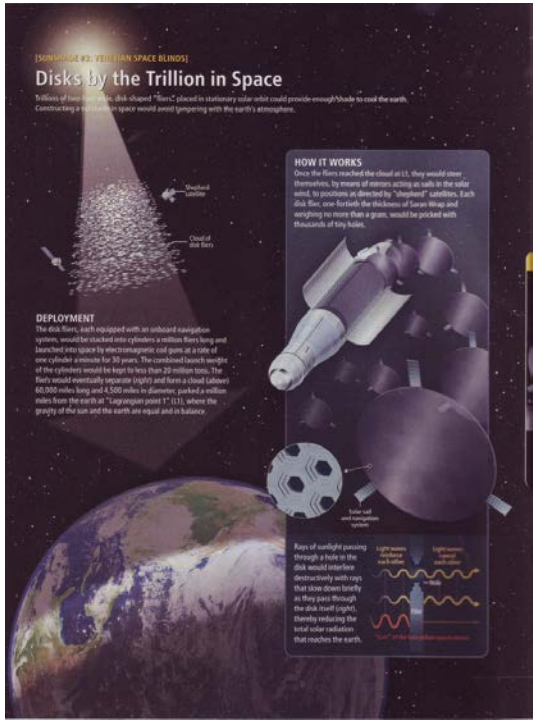
- Trotz dieser gravierenden Probleme fallen diese noch unter die Kategorie **gute Nachricht.**
- Denn all diese Probleme konnten im Falle der FCKW (Ozonloch) global und schnell gelöst werden und auf einer kontinentalen Ebene gilt das auch für die Schwefeloxide.
- Gemeinsamer Nenner: Es gab bereits bekannte und nicht zu kostenintensive Substitute (das sich dann allerdings als Treibhausgas herausgestellt hat) und Techniken (Rauchgaswäsche).
- Da es keine guten Substitute für fossile Brennstoffe gibt, bleibt das Innovationsproblem bestehen.

Lösungsstrategien

- Effizienzsteigerungen
- Erneuerbare Energie
- Aber weniger Technik im Allgemein und dabei wiederum sind CCS wenig und Geo-engineering (zu billig!) gar nicht beliebt.







Mythos der Effizienzsteigerungen

- **Falsche Prämissen**

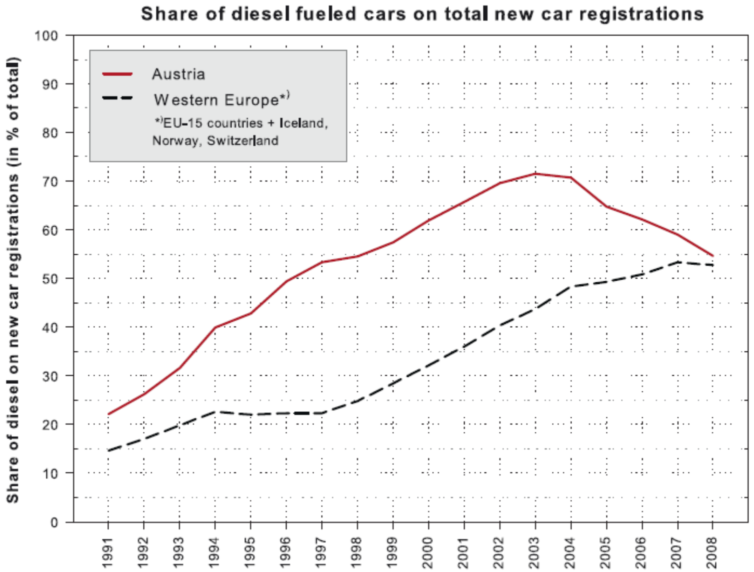
  – **Dumme** Konsumenten => Regulierung
  "*… an economic actor on average knows better the environment in which he is acting and the probable consequences of his actions than does an outsider, no matter how clever the outsider may be*", Hayek
  Gegenbeispiel: Diesel-Pkws in Österreich

  – Effizienzsteigerungen (Innovationen) beding durch Preis vs. Standards
  Event study – CAFE, EU

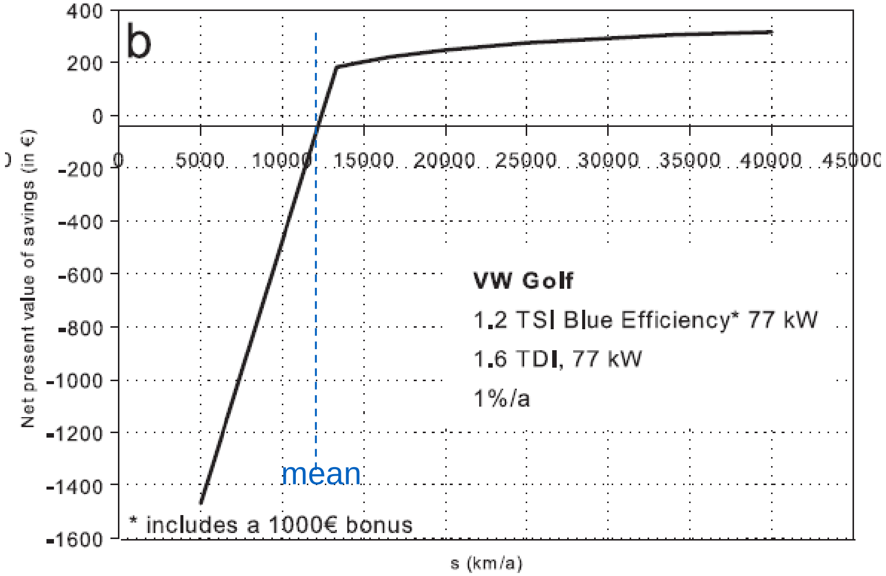
Dummme (ungeduldige) Konsumenten?

Diesel- vs Benzinautos in Österreich

	1999/2000	2003/2004	2005/2006	2007/2008
Average yearly kilometers driven (per automobile)				
Gasoline	12,032	11,950	11,429	11,342
Diesel	15,965	16,334	15,680	15,232
Other		14,011	11,426	9885
Total	13,461	14,142	13,740	13,497

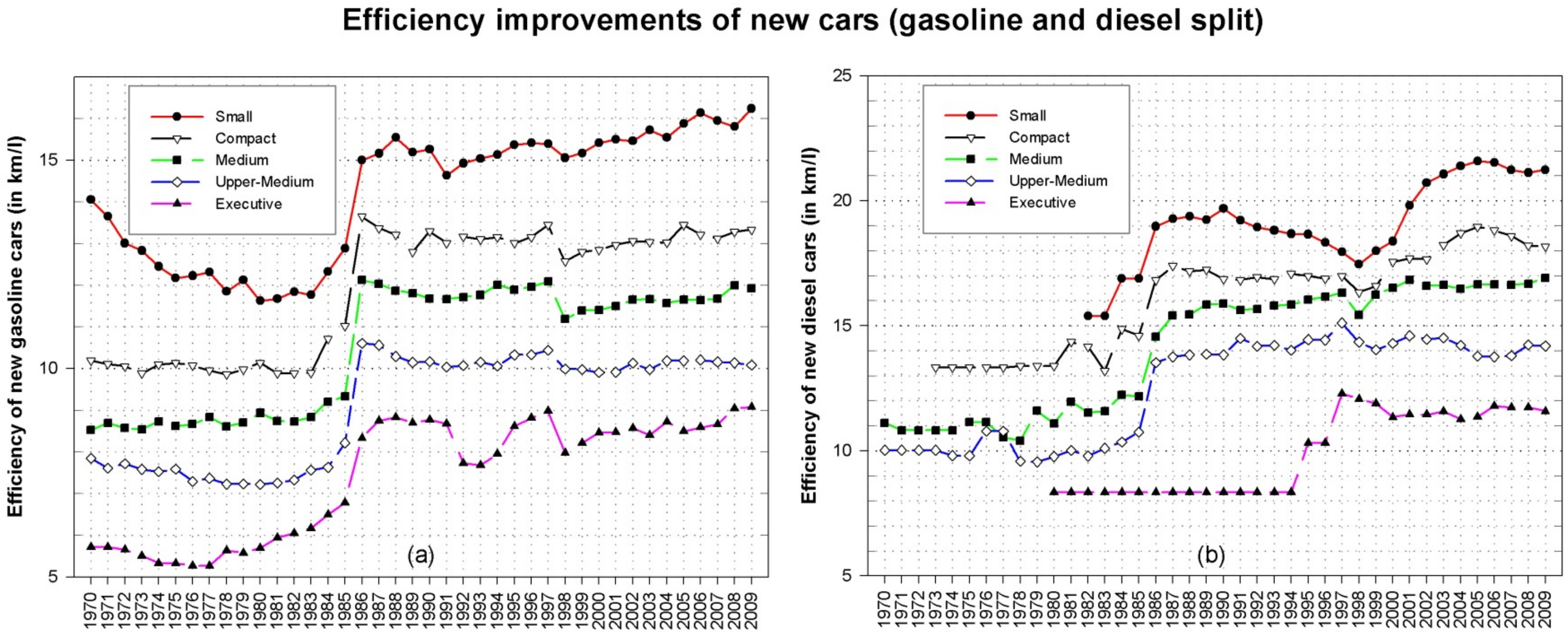


NPV from diesel engine vs mileage



Roland Görlich and Franz Wirl, Interdependencies between Transport Fuel Demand, Efficiency and Quality: An Application to Austria, *Energy Policy* 41, 47-58, 2012.

Innovationen beding durch Preis oder Standard? Vorschlag: Event study – CAFE, EU



[Data source: Auto Motor Sport 'Auto Katalog' various publications, own calculations]

Mythos der Effizienzsteigerungen

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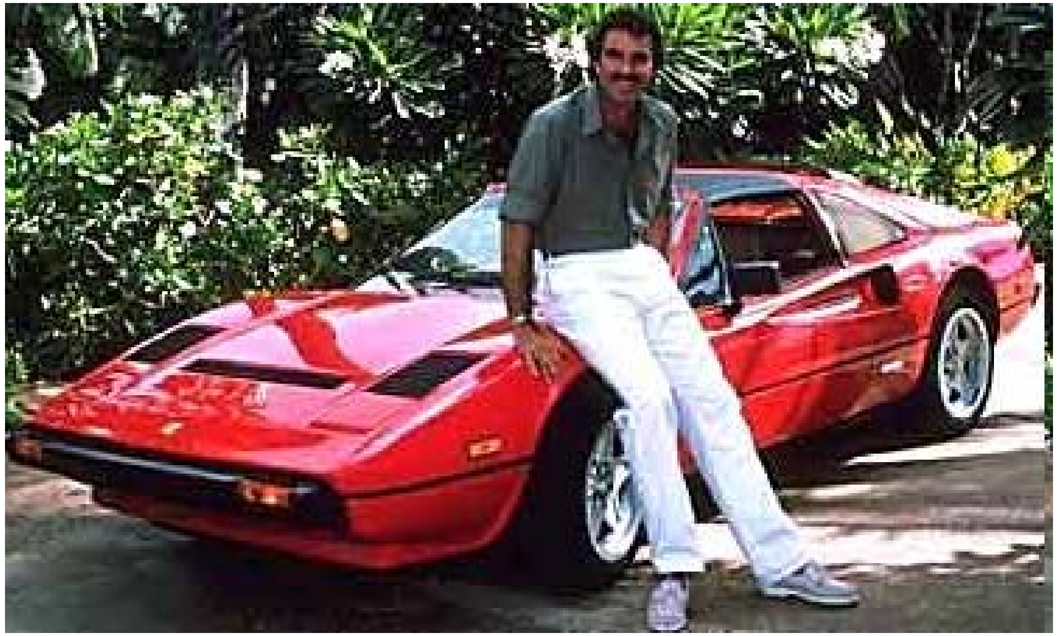
    "*… an economic actor on average knows better the environment in which he is acting and the probable consequences of his actions than does an outsider, no matter how clever the outsider may be*", Hayek
    Gegenbeispiel: Diesel-Pkws in Österreich
  - Innovationen
  - **Lokale Politiken** können die Technik nicht beeinflussen**.**
  - **Effizienzsteigerung = Energieeinsparung,** damit Übersehen des **Rebounds**: „Effizienterer Einsatz erhöht die Nachfrage" zumindest nach der Dienstleistung aber möglicherweise auch dem Input (Brennstoff, Jevons*).

* "It is wholly a confusion of ideas to suppose that the economical use of fuel is equivalent to a diminished consumption. The very contrary is the truth…Every improvement of the engine, when effected, does but accelerate a new the consumption of coal"

Ein Beispiel für den Rebound (nicht nur km)



Ferrari 308 GTS
230 PS*, 0-60 mi in 7.3 sec.

The 308 was capable of producing 255 bhp from its 3 liter, V8, carburetor engine. In 1980, a Bosch K-Jetronic fuel injection system was installed due to new emission regulations. This caused the horsepower to drop to around 215 hp, thus making the 308 GTBi the slowest of the 308 series.

In 1981, Ferrari introduced 4 valve heads for the 3 liter V8's. This 308's now became known as 308 GTB/GTS Quattrovalvole. The engine now produced 240 BHP, and with the extra weight that was imposed due to using all-metal rather than fiberglass, the performance and handling was back to where it was when it began production.

Toyota RAV4 2010
269 PS, 0-60 mi in 7.3 sec.
(das Auto der amerikanischen Fußballmutter)

Like the Tin Man in "The Wizard of Oz," a body of metal is nothing without a heart. Thankfully, the 2009 Toyota RAV4 -- when fitted with the optional V6 -- has plenty of heart, thanks to 269 horsepower, potent acceleration and a modest appetite for fuel. In fact, this V6 gets about the same fuel economy as some four-cylinder-equipped competitors.

*from Sperling who gives slightly different numbers for the Ferrari than the quote from Wikipedia:
http://www.almaden.ibm.com/institute/resources/2009/presentations/DanielSperling-AlmadenInstitute2009.pdf

Effizienzsteigerungen

- Effizienz ist kein freies Gut
- Ist von globalen Bedingungen und (großteils) ökonomisch bedingt (Bsp. Autos) – österreichische Alleingänge verpuffen.
- **Politikversagen -** durch die Bank ineffiziente Maßnahmen:
  Standards (EU - Staubsauger!),
  NOVA (ein Stauproduzent, Leviathanmotiv dahinter?)
  CAFE, EU-Flottenstandard
  weiße Zertifikate (‚to make the butcher sell fish', Larry Ruff) notabene unter Vernachlässigung von Rebound und Schwarzfahrern,
  JI und CDM,
  etc.

Erneuerbare Energie

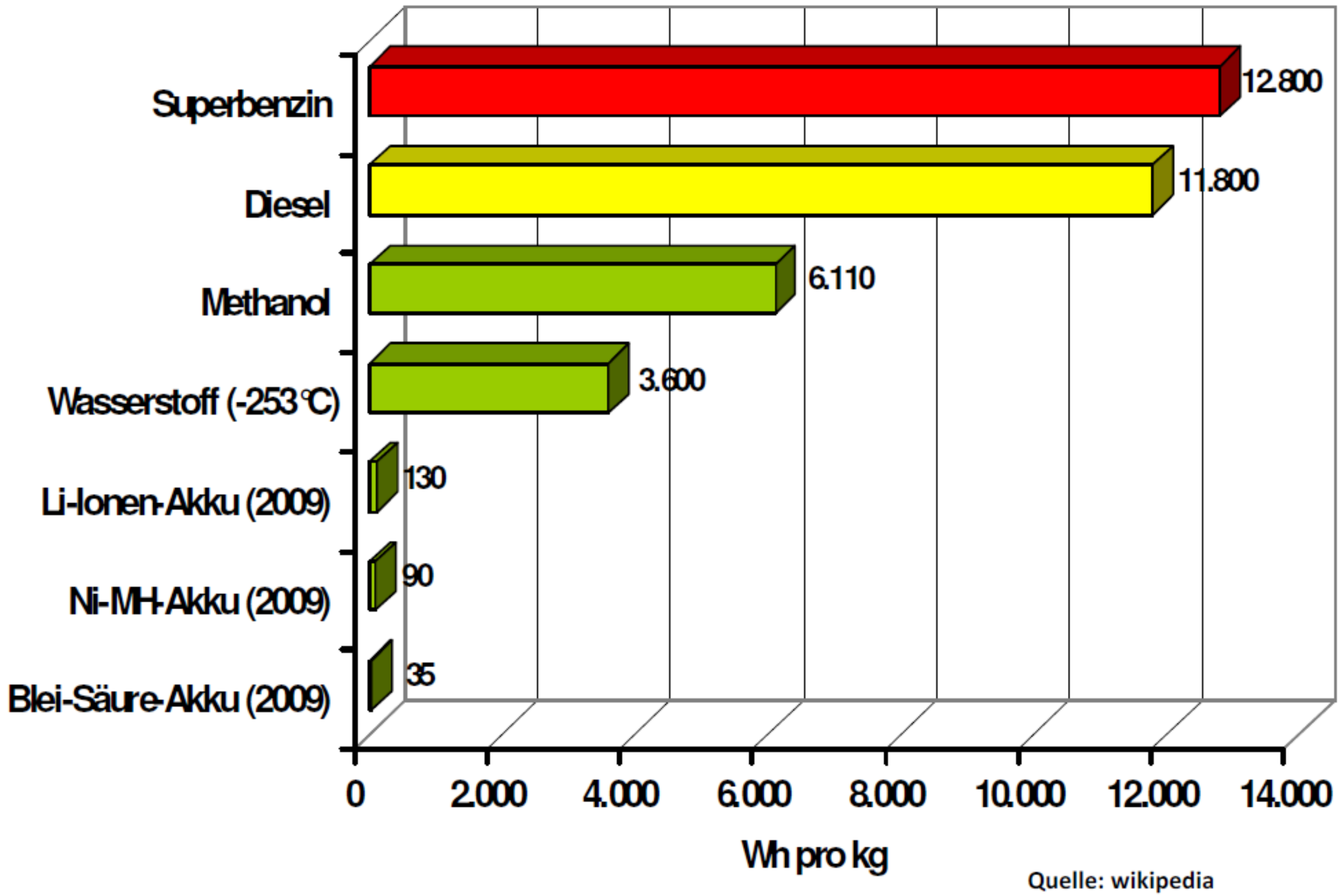
- Erneuerbare Energie hat über Jahrtausende das Leben und die Wirtschaft bestimmt:
  - u.a. die Größe der Städte (Scott Taylor)
    und dadurch (Glaeser, anders als bei G. Clark) das Wirtschaftswachstum beschränkt
  - 1/3 der Agragflächen für Hafer (‚Treibsoff') für 21 Millionen Pferde in den USA um 1900
- (absurde) Renaissance in **A**: Versorgungssicherheit, regionale **Energieautarkie**!
- Grüne Jobs sind eine Illusion (unter Freihandel),
  vgl. Bankrott von *Odersun, First Solar, Güssing.*

Harte Beschränkungen*

- Das Potential der Bioenergie kann durch 3 Zahlen bestimmt werden: Intensität der Sonneneinstrahlung, Effizienz der Photosynthese und verfügbare **Flächen**.
- “Meeting Britain’s energy needs from **onshore wind power** would require covering literally the entire country in turbines, even assuming that the wind was guaranteed to blow. If only 10% of Britain were covered then wind could provide roughly a tenth of total demand. **Switching every piece of agricultural land to biofuel production would provide just 12% of the requisite juice**.”
- “It is a similar story for **offshore wind**, tidal and wave energy: To make a dent in fossil-fuel consumption without using nuclear power, renewable-energy facilities will have to be “country-sized”, with offshore wind farms bigger than Wales and huge solar-power arrays in sunny deserts piping power to cloudier nations.”
- Richard Feynman “nature cannot be fooled”
(langfristig nicht einmal ökonomische Gesetze, kurz- bis mittelfristig leider ja)

* David MacKay, *Sustainable Energy without the Hot Air*, 2009.

Energiedichte von Treibstoffen



Quelle: wikipedia

Niedrige Energiedichte erneuerbarer Energien*

Table 1: Power Density Crops

Crop	Yield $[kg/m^2]$	Energy Content $[MJ/kg]$	Power Density W/m^2
Sugar cane	7.16	17.01	3.86
Sugar beet	4.87	9.75	1.50
Cassava	1.25	6.69	0.27
Bananas	2.05	3.73	0.24
Rice, paddy	0.43	15.5	0.21
Potatoes	1.78	3.22	0.18
Sweet Potatoes	1.25	3.60	0.14
Wheat	0.30	15.07	0.14
Barley	0.26	14.74	0.12

Note: Data are shown in the Appendix.

Table 3: Power Density of Wind and Sun

Region	Solar	Wind	
	Power Density $[W/m^2]$	Speed $[m/s]$	Power Density $[W/m^2]$
Northeast	164	7	122
North Central	226	9	281
Southeast	217	7.5	136
South Central	219	7	115
Rocky Mountain	256	9.5	296
Pacific Coast	229	7.5	144

Note: Data are shown in the Appendix.

Juan Moreno Cruz und M. Scott Taylor, A SPATIAL APPROACH TO ENERGY ECONOMICS

Energiedichte von Holz*

Table 2: Power Density of Wood

Forest Region	Total Acres (1,000s)	Ave. Prod. (ft^3/acre/yr)	Percent Softwood	Percent Hardwood	Average Power Dens. (W/m^2)
Northeast	79,803	57.10	25.21%	74.79%	0.10
North Central	84,215	66.54	18.72%	81.28%	0.12
Southeast	85,665	80.22	41.00%	59.00%	0.14
South Central	118,364	84.69	35.20%	64.80%	0.15
Rocky Mountain	70,969	52.00	90.29%	9.71%	0.08
Pacific Coast	75,197	81.71	89.01%	10.99%	0.12

Note: Data are shown in the Appendix.

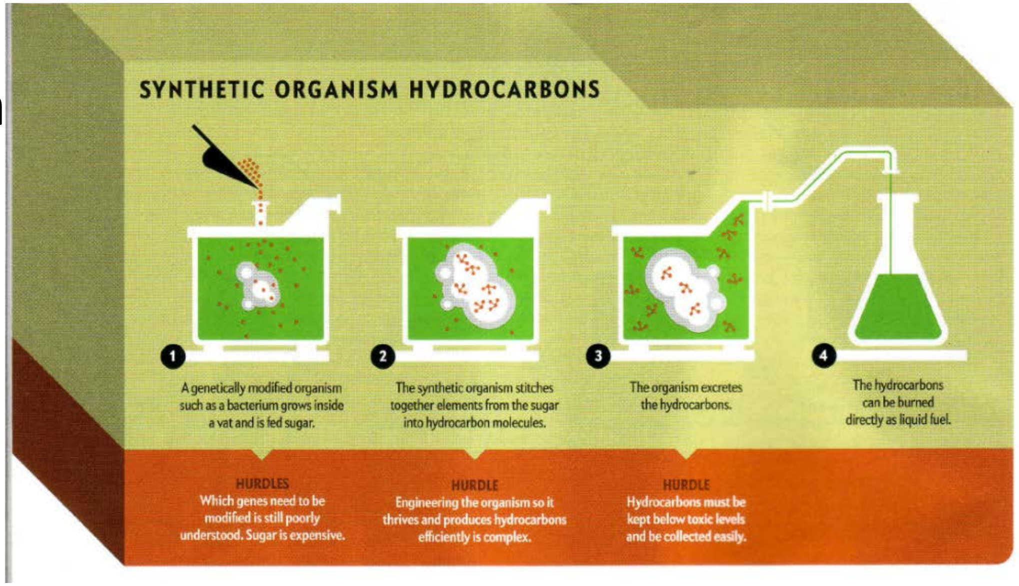
Konsequenz: Verstromung ist die nahezu einzig sinnvolle Lösung, was aber die Notwendigkeit einer starken Ausweitung des Stromangebots bedarf, weil Strom nur etwa 20% des Energieendverbrauches abdeckt.

Wind und PV führen dazu, dass gigantische Mengen gespeichert werden müssen, großteils über die Saisonen hinweg (vom Winter in den Sommer, also Smart-Homes & Grids können das nicht lösen!).

H. W. Sinn: Wind & PV 50% des Stromverbrauches erfordert ca 150 Millionen (D 43 Mill Autos) BMW-i3s, die aber nicht fahren dürfen, oder eine Unmenge an Speicherkraftwerken, mind. 500 zu Kosten von 35 Atomkraftwerken mit dem Output aber nur 4.5 Atomkraftwerken.

Trugschlüsse

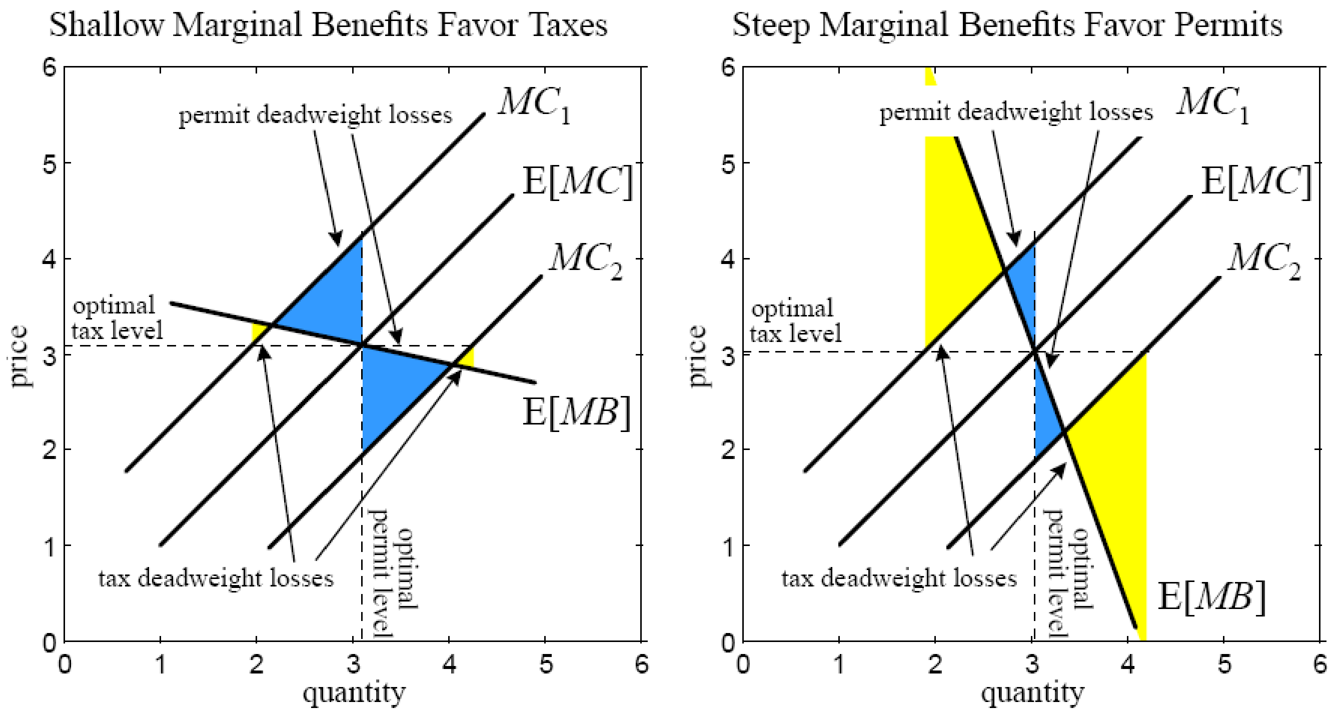
- Unterschätzung der Kosten von alternativer Energie, seit Carters *Project Independence*
- Ineffiziente und meist zu optimistische Prognosen, vgl. Biotreibstoffe
- Optimismus hinsichtlich F&E: garantiert die Lösung (Fermats letzter Satz, Pest im Mittelalter, Krebs)
- Alte Technologien wie PV, Elektroauto und Batterien
- Lösung *Österreichisch*?
  Carbon **C**apture and **S**torage,
  SO2 Zertifikate US, ETS und EVUs
  Schiefergas in den USA
- Inputproblem (vgl. Craig Venter, Agrana 2008!)



Wahl der Regulierungsinstrumente
Politik vs Ökonomie und (private) Interessen der Politiker

- **Ökonomie oder Politik dominant?**
  + Ökonomie: Adam Smith, "It is not from the benevolence of the butcher, the brewer, or the baker that we expect our dinner, but from their regard to their own interest. We address our-selves not to their humanity but to their self-love and never talk to them of our own necessities but of their advantage."
  + Politik: Sozialistische Planwirtschaften (40a Osteuropa, 70a SU)
  öst. Elektrizitätswirtschaft (zumindest bis 1999).
- Buchanan-Tullock zu den Standardannahmen in der Wohlfartsökonomik:
  ".. that the individual must somehow shift his psychological and morale gears when he moves between the private and social aspects of life"
- Unverständlicherweise nachwievor meist ignoriert!

Politikversagen - CO2 Zertifikate anstatt Steuern



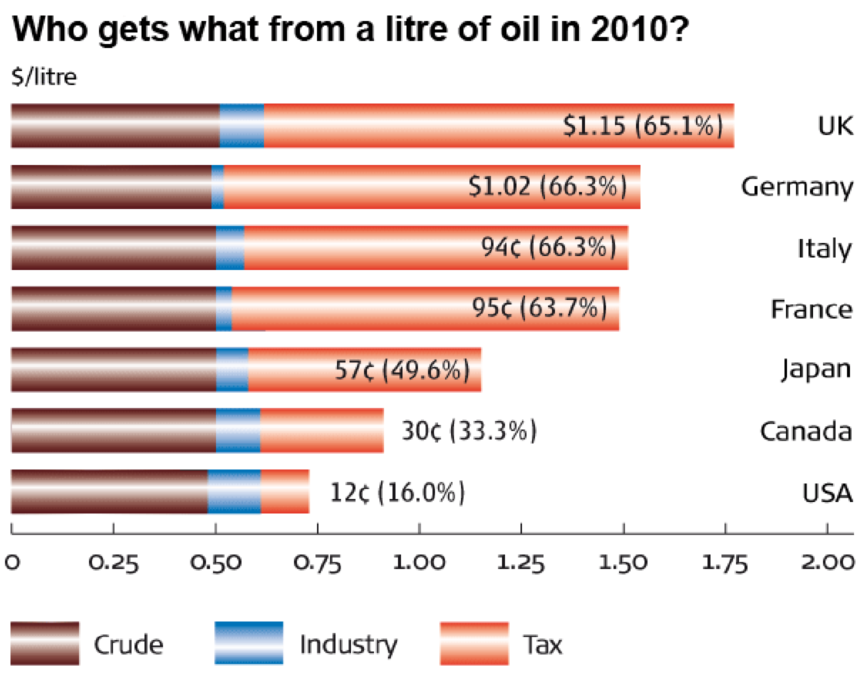
[a] E[MB] indicates expected marginal benefits, E[MC] indicates expected marginal costs, and MC_1 and MC_2 indicate alternative cost outcomes.

aus Pizer (basierend auf M. Weitzman (1974), *Review of Economic Studies* 41: 477-491

Wirl 2013: Rentenwettkampf zwischen Energieexporteuren (OPEC) und –importeuren (OECD) unterm Treibhauseffekt => **Steuern dominieren Zertifikate aus der Sicht der Energieimporteure.**

Politikversagen Zertifikate anstatt CO2-Abgaben

- Traditionell wurde besteuert und dieses Aufkommen ist groß
- Aber momentan Mengenstrategien der EU (und der OPEC)
- Schlecht (für beide)
- **Steuern** und Preise sind aus strategischer Sicht die 1. Wahl
- Versuch einer Erklärung: **Eigeninteresse der Politiker**. Täuschung? (Kostenlose) Zertifikate werden den Strompreis nicht erhöhen, ähnlich 2008 von Obama-Sarkozy-NL&NZ-Strache, jüngst der Vorschlag der Flexsteuer.



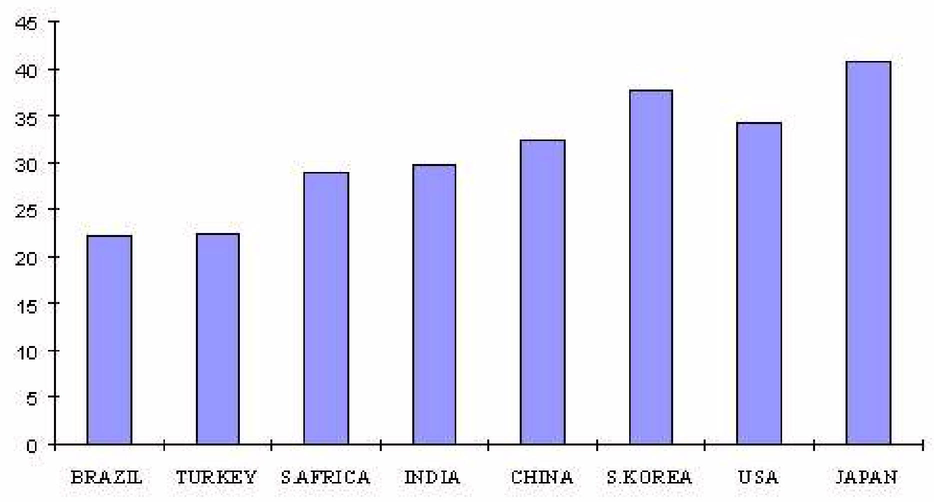
Energie & Umweltabgaben = 10% in D

Politikversagen bei der Gestaltung von Anreizen: Ignoranz privater Information

- Hayek gegen Lange
  aber explizit 3 Nobelpreise (an 8 Preisträger) + Jean Tirole (2014), Holmström (2016),
  China (& dismal science)
  Elias Canetti
- *Joint Implementation* (JI),
  Clean Development Mechanism (CDM)
  Emissionsmindernden Maßnahmen erwerben zusätzliche Emissionsrechte für heimische Schadstoffproduzenten
  JI: Land *a* aus Annex I-A in Land *b* aus Annex I-B
  CDM: Annex I in Nicht-Annex I
- Energiesparen - Subventionen,
  jüngst: *weiße Zertifikate*
  Energieeinsparungen, die EVUs durchführen (oder sich freikaufen durch Aktionen anderer) müssen
- *Die Presse*, 25.8.2015, **Russische Firmen verdienten Millionen an Klimatricksereien**

Bsp.: JI & Investition in Kraftwerke

		Investition [10^9 $]	Effizienz [%]	CO_2 Emission	CO_2 Reduktion
ohne JI:	Land A	0.8	**35**	1	
mit JI:	Land A	0.8	35	1	
	Land B	0.3	**45**	0.78	**0.22**



Strategische Reaktion bei privater Information

		Investment [Bill.$]	Efficiency [%]	CO_2 emissions	CO_2 reduction
without JI:	Country A	0.8	**35**	1	
with JI:	Country A	0.8	35	1	
	Country B	0.3	**45**	0.78	**0.22**
strategic JI	Country A	0.65	28	1.25	
	Country B	0.45	**45**	0.78	**0.47**

=> **A und B schwindeln**!

Tatsächlich findet hier Schwindeln im großen Maßstab statt!

Beispiel, The smoking greenhouse gun, *The Economist*, Sep. 2nd, 2010

ONE of the curiosities of carbon markets is that they do not just trade in carbon. Other greenhouse gases can be given a value, too—sometimes a very high one. Claims that these prices promote scammery are now prompting some searching questions.

The gas at the centre of the controversy is HFC-23, a greenhouse gas which, on a weight-for-weight basis, is 14,800 times better at trapping heat than carbon dioxide. HFC-23 is produced as a by-product of the manufacture of HCFC-22, an ozone-destroying refrigerant. HCFC-22 is banned in developed countries, but developing countries can keep making it until 2030.

The acronyms do not end there. Under the Clean Development Mechanism (CDM) of the United Nations HCFC-22 producers in developing countries that destroy, rather than release, their HFC-23 can be eligible for Certified Emission Reduction (CER) credits, which can then be traded in the European Union's emissions-trading scheme. This allows companies to buy extra emissions reductions to meet their cap-and-trade obligations, and in so doing to transfer money to schemes reducing emissions in developing countries.

Wind farms, solar programmes and other clean-energy projects are all eligible for CERs. But because destroying a tonne of HFC-23 is a lot cheaper than avoiding the emission of more than 10,000 tonnes of carbon dioxide, HFC-23 destruction has become the CDM's principal source of emissions credits. According to Sandbag, an outfit that monitors carbon markets, 59% of the CERs used as offsets in the EU cap-and-trade scheme in 2009 came from HFC-23 projects, representing more than €500m ($695m) in credits.

You cannot simply set up an HCFC-22 plant and demand cash; eligibility is limited to companies which were already producing the gases in 2000-04, and companies are capped in the amount they can receive. But there is little incentive for approved incineration schemes to reduce the amount of HFC-23 that they produce. Quite the reverse, argues CDMwatch, a group that monitors the offset market. It says it has shown the CDM executive board that some plants have reduced their HFC-23 production during periods in which they were ineligible for CERs and upped it when they became eligible again, gaming the system. "They found the smoking gun," says Michael Wara, a professor at Stanford Law School.

Since the executive board received that submission in July, eight HFC projects have been placed under review. The CDM's methodology panel is looking again at the way that HFC-23 schemes are assessed. According to Point Carbon, a market-intelligence firm, three countries on the board, which numbers ten in all, are putting applications for increased production from HFC-23 makers out to review as a way of stopping new issuance until the methodology is revised. The supply of CERs is likely to dry up over the rest of the year.

Longer-term demand for HFC-23 CERs may fall, too. Connie Hedegaard, the EU's climate commissioner, is calling for the role industrial-gas CERs are allowed to play as offsets to be reassessed for the trading scheme's next phase, which will run from 2013 to 2020. A Deutsche Bank analysis suggests that by reducing supply, a tough stance on this issue could drive the spot price of a tonne of carbon up from today's €15 to €25 by the end of the year.

A more spectacular risk, Point Carbon's Kjetil Roine points out, lies in rules to be discussed at the next meeting of the CDM's executive board in mid-September. These could make the entities responsible for CER issuance liable for replacing CERs issued incorrectly in the past. If some HFC-23 CERs were deemed retroactively invalid, such sanctions would drive up the price of other CERs while putting some of these entities in serious financial trouble.

There is some good news. Until recently it appeared that, despite the large amounts of money changing hands, HFC-23 emissions had been steadily increasing. A study by Ben Miller of America's National Oceanic and Atmospheric Administration and colleagues published recently found that in fact emissions fell by 40% or so between 2006 and 2009. But at a very high price.

Unzählige andere **nichtanreizkomatible** Beispiele

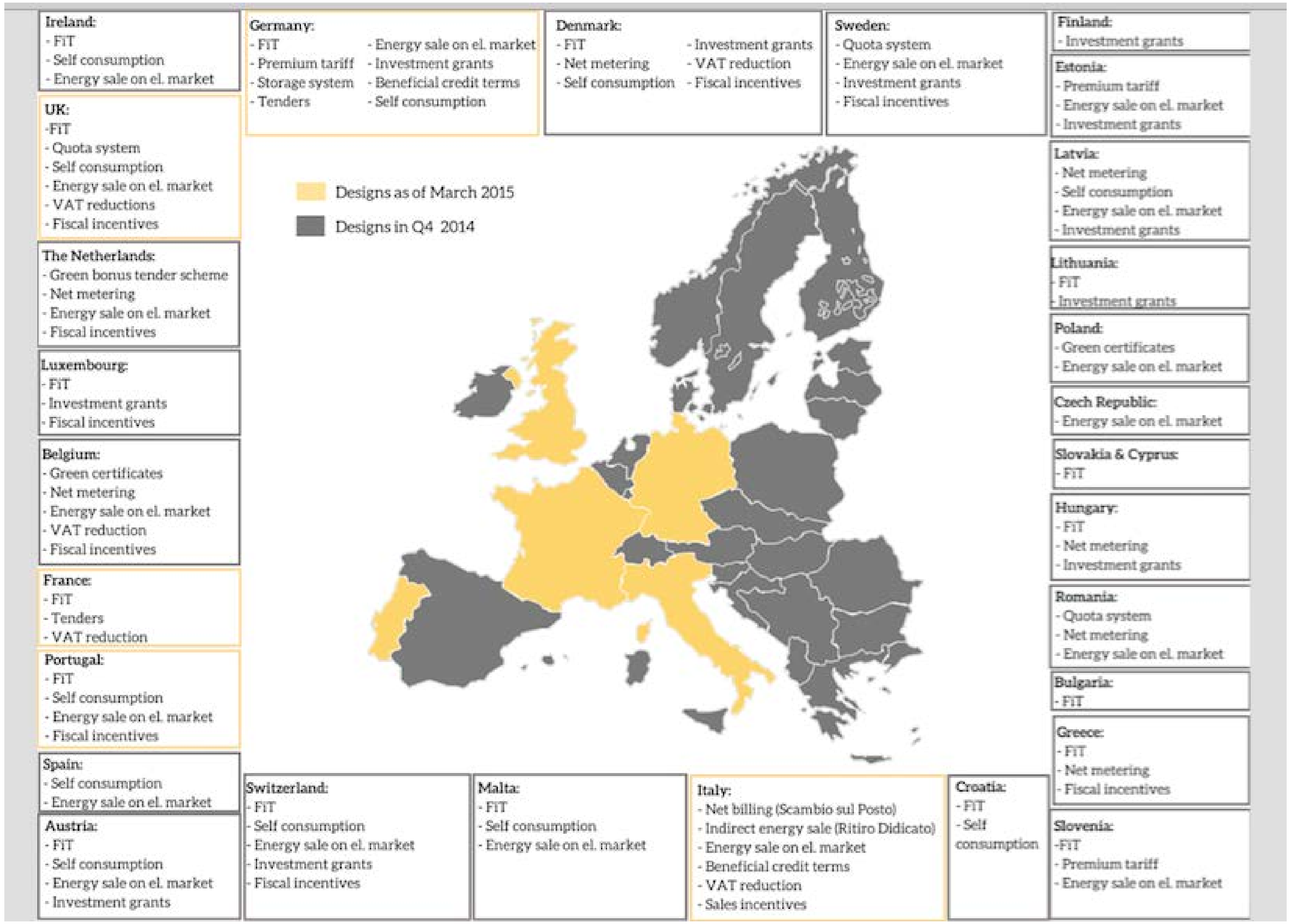
- Sozialpolitik
  BMS
  Pflegeversicherung,
  Frühpension
  Behindertenzuschuss/Invalidenpension

  } 'you get what you pay for'

- Subentionen von der Landwirtschaft bis hin zu Sonnenkollektoren

Denn jeder ist versucht private Information so darzustellen, dass sie einem nützt, Oscar Wilde, I can resist anything but temptation, Pater Noster.

PV-Förderstrategien



Zusammenfassung

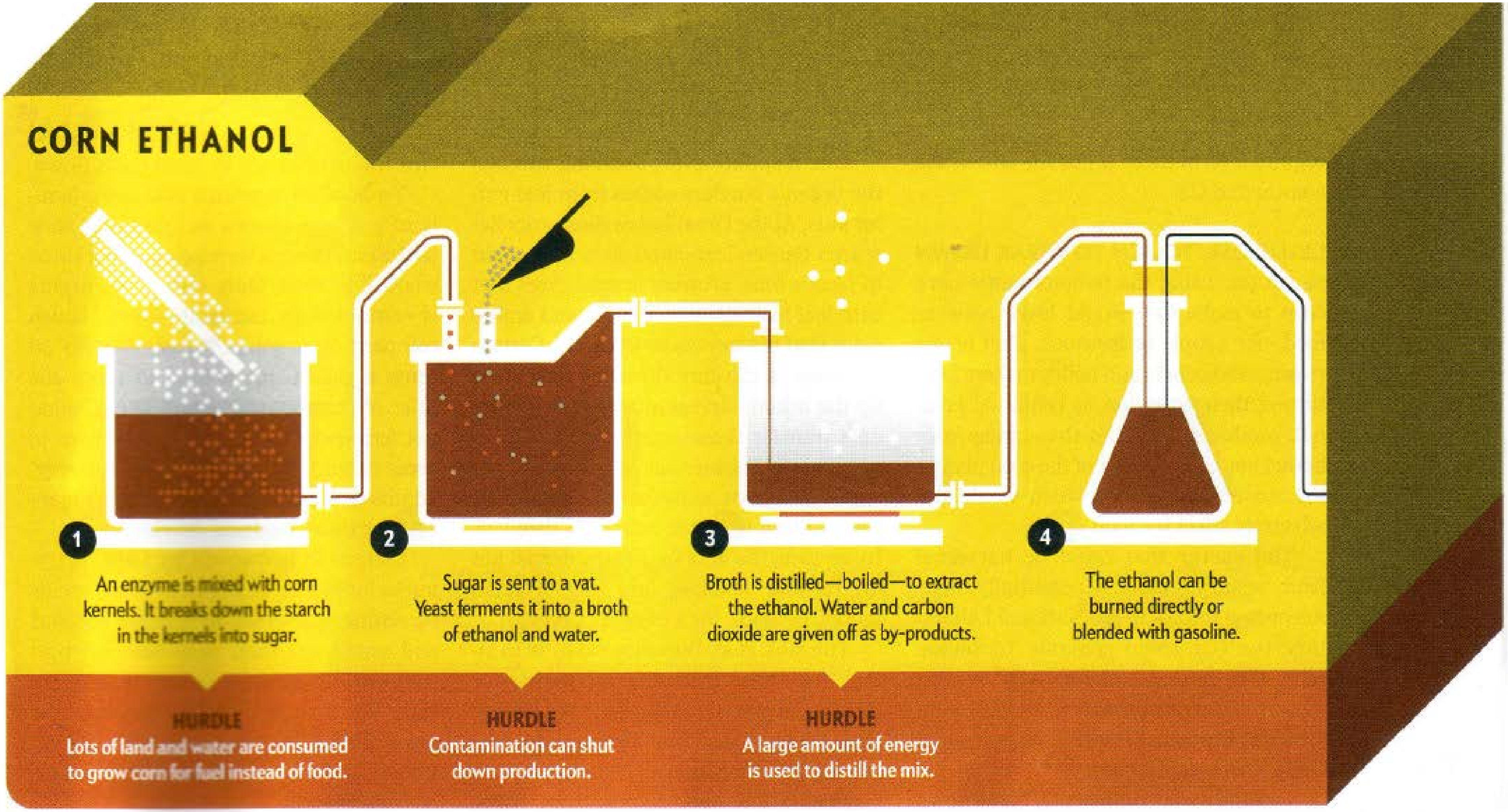
- Das Klimaproblem ist relevant.
- Leider eine harte Nuss und zwar primär technischer Natur, denn die durchaus gravierenden ökonomischen Probleme scheinen lösbar (vgl. FCKWs und jetzt FKWs).
- Daher sind Versprechen wie: wir machen das (locker*) mit Effizienzsteigerungen und den geringen Rest machen wir erneuerbar nicht dienlich, wenn wirkliche unseren Komfort betreffende Maßnahmen notwendig werden.
- Die Subventionen von nicht effektvollen Techniken (und auch sehr alten wie Wind, PV) sollten in Grundlagenforschung umgelenkt werden, um wirklich taugliche Lösungen zu finden (und ohne *trade off* wird es kaum gehen!).
- Wegen der Bedeutung kann auf effiziente ökonomische Instrumente **nicht** verzichtet werden!
- **Warum werden so viele Anreize von der Politik schlecht gestaltet? Bewußt?**
  Im Falle der Klimapolitik auf höchster Ebene (UNO und EU)

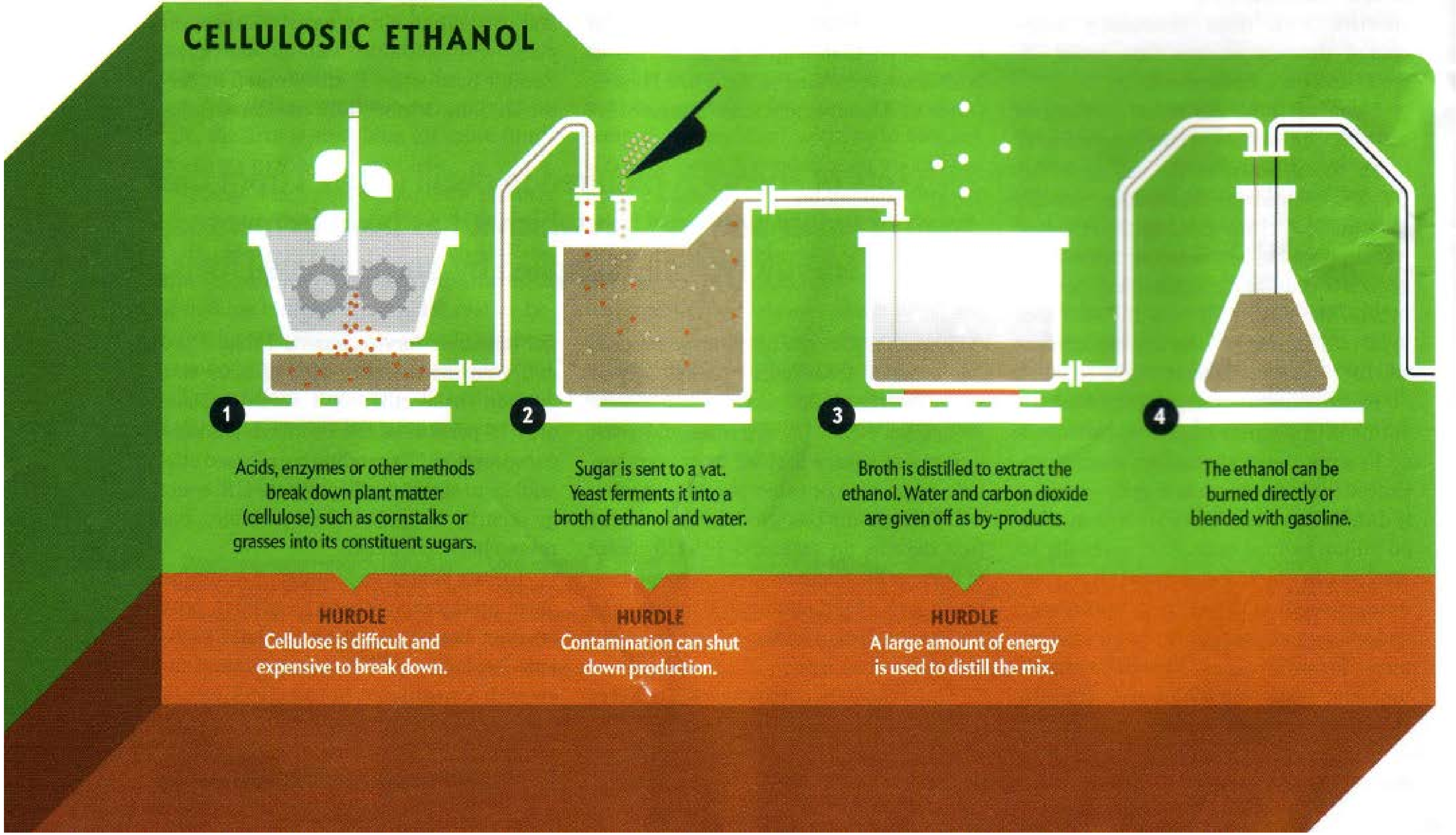
* ein wenn nicht der öffentlich bekannteste Klimaökonom Ös versprach Mitte der 90-er, dass wir in 20a (also heute) 2/3 der Energie (nicht Strom!) erneuerbar machen „und das mit Links“.

Danke für Ihre Aufmerksamkeit!

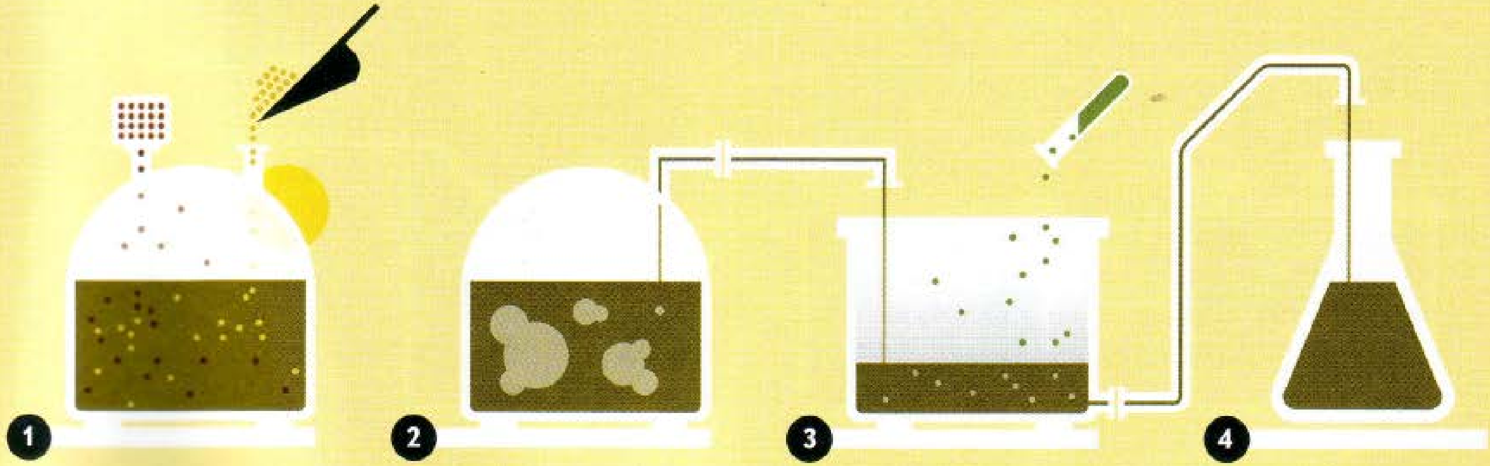
Appendix

- Bsp. Erneuerbarer Treibstoffe
- Modell zu F&E in erneuerbare Energie
- Schwindeln bei JI, CDM & sogar ETS


CORN ETHANOL
1
An enzyme is mixed with corn kernels. It breaks down the starch in the kernels into sugar.
2
Sugar is sent to a vat. Yeast ferments it into a broth of ethanol and water.
3
Broth is distilled—boiled—to extract the ethanol. Water and carbon dioxide are given off as by-products.
4
The ethanol can be burned directly or blended with gasoline.
HURDLE
Lots of land and water are consumed to grow corn for fuel instead of food.
HURDLE
Contamination can shut down production.
HURDLE
A large amount of energy is used to distill the mix.


CELLULOSIC ETHANOL
1
Acids, enzymes or other methods break down plant matter (cellulose) such as cornstalks or grasses into its constituent sugars.
2
Sugar is sent to a vat. Yeast ferments it into a broth of ethanol and water.
3
Broth is distilled to extract the ethanol. Water and carbon dioxide are given off as by-products.
4
The ethanol can be burned directly or blended with gasoline.
HURDLE
Cellulose is difficult and expensive to break down.
HURDLE
Contamination can shut down production.
HURDLE
A large amount of energy is used to distill the mix.

ALGAL OIL



1. Algae in a pond or vat are exposed to sunlight and fed carbon dioxide and nutrients.

   HURDLE
   Nutrients are expensive.

2. As algae grow, they produce oils inside their cell walls. Mature cells are collected by various means.

   HURDLES
   Competing strains can kill the batch. Algae grow slowly when producing oil.

3. A chemical solvent dissolves the cells, killing them and releasing the oils.

   HURDLE
   Collecting the oil can use as much energy as the oil contains.

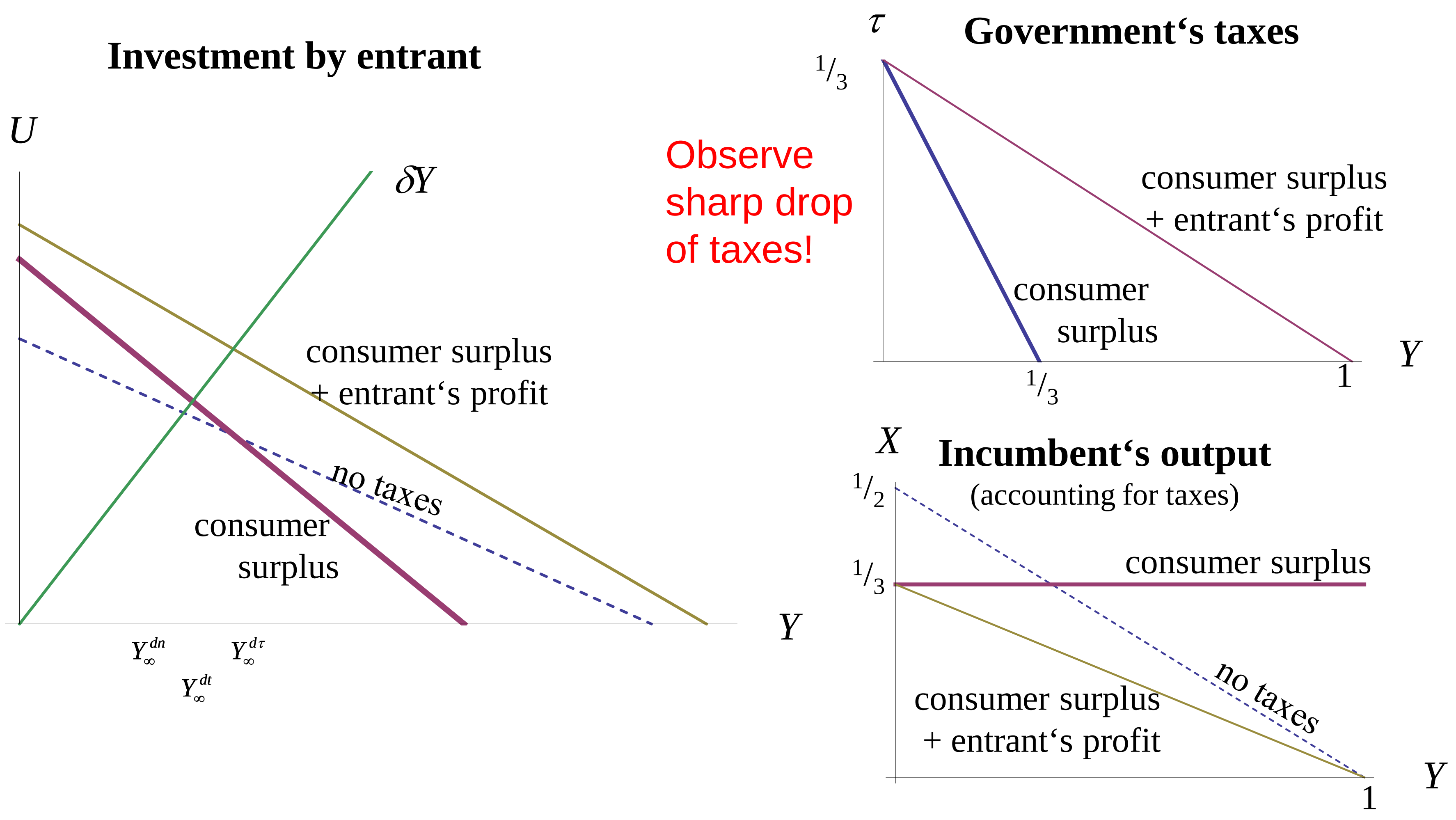
4. The oils are refined into a variety of fuels such as biodiesel or bio-jet fuel.

   HURDLE
   Refining requires specialized equipment.

Innovation of green technologies via taxes or permits.

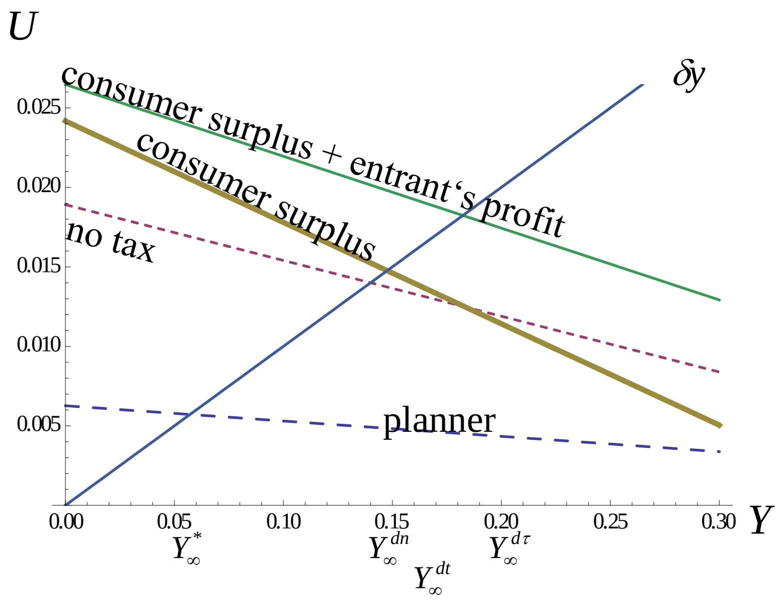
Franz Wirl, Taxes versus permits as incentive for the intertemporal supply of a clean technology by a monopoly, *Resource and Energy Economics* 36, 248-269, 2014

Strategies for different government's objectives



Duopoly

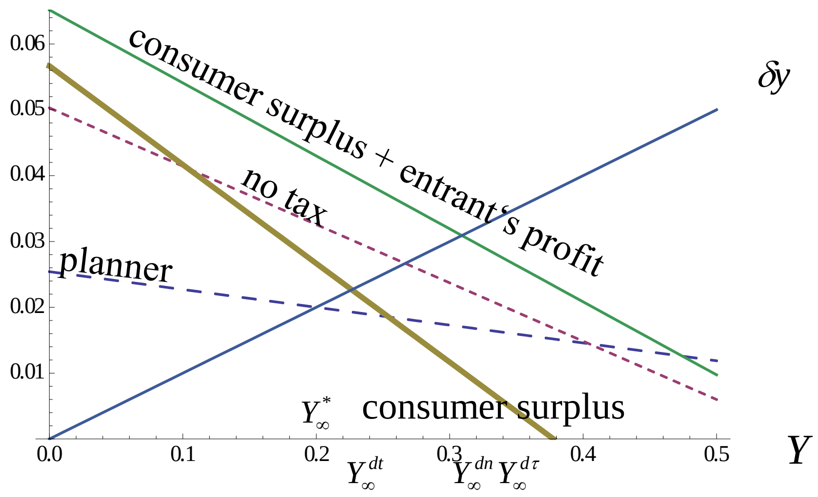
Investment strategies (U) versus capacity (Y) – duopoly



Scenario 1:

Taxing **increases** entrant's supply

$\gamma = 100$, $r = 0.05$, $\delta = 0.10$, $c = 1$

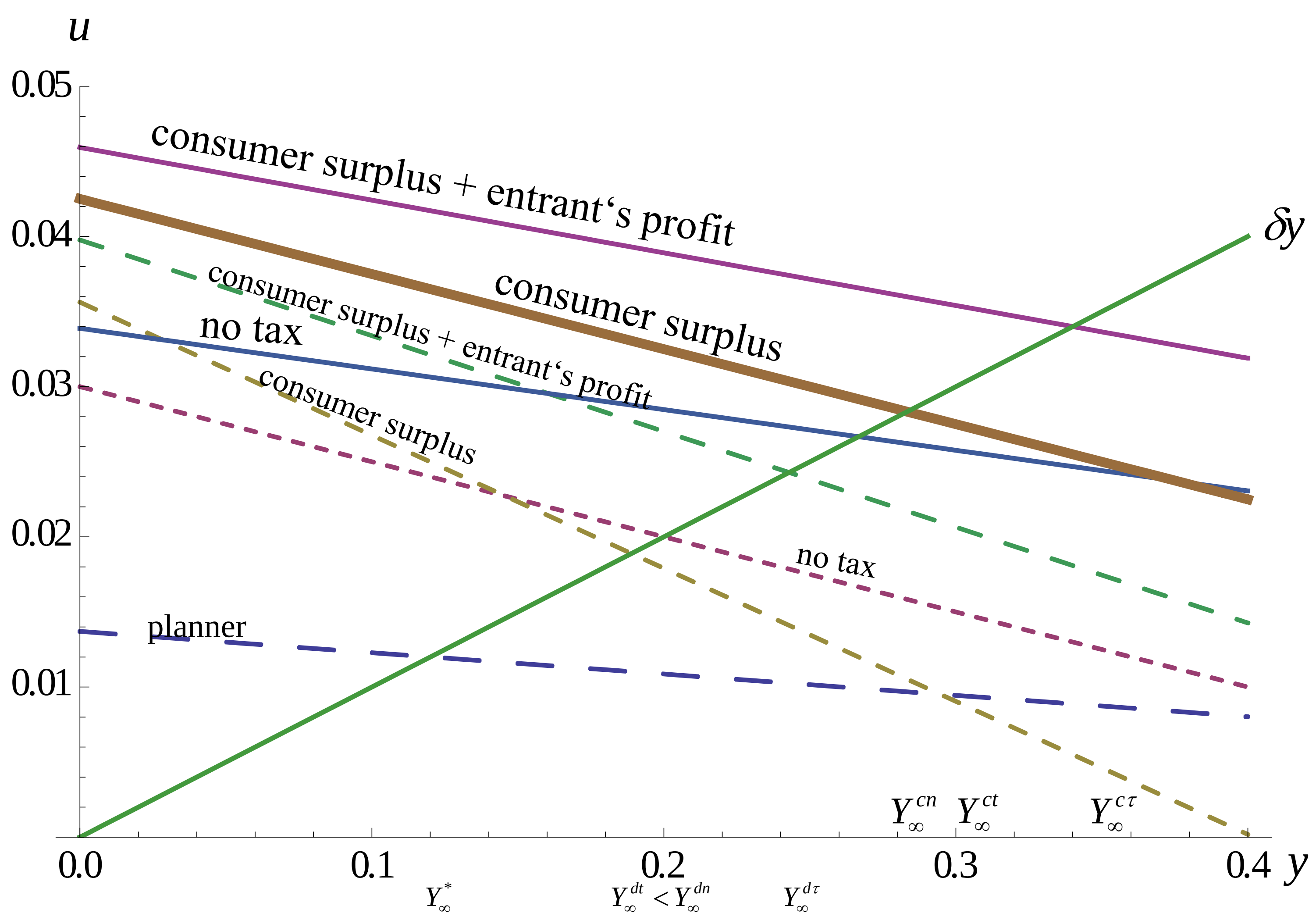


Scenario 2:

Taxing **decreases** entrant's supply

$\gamma = 50$, $r = 0.05$, $\delta = 0.10$, $c = {}^2/_3$

Primary objective is **rent transfer**, and not support of renewables!



Investment strategies ($u = U$) versus capacity ($y = Y$) for different objectives and competitive entrants versus duopoly (dashed, violating (42)),
$\gamma = 100$, $r = 0.05$, $\delta = 0.10$, $c = {}^2/_3$.

White Certificates*

What counts as *energy conservation*?

Are rebound, adverse selection and moral hazard of participating consumers included? NO! Bertoldi' (2011), "90% of the savings delivered via projects submitted to date are of the deemed saving and engineering method variety“

What basis? Own Reports? Installed equipment? => **cheating**
Duration?

Therefore assumption: only efficiencies exceeding a threshold ($\underline{\eta}$) qualify for permits.
If the benchmark efficiency is too high only few will sign up, if it is too low, subsidies have to be wasted on anyway voluntary choices of efficiency.

* *Wikipedia*, white certificates are documents certifying that a certain reduction of energy consumption has been attained. In most applications, the white certificates are tradable and combined with an obligation to achieve a certain target of energy savings. Under such a system, producers, suppliers or distributors of electricity, gas and oil are required to undertake energy efficiency measures for the final user that are consistent with a pre-defined percentage of their annual energy deliverance. If energy producers do not meet the mandated target for energy consumption they are required to pay a penalty. The white certificates are given to the producers whenever an amount of energy is saved whereupon the producer can use the certificate for their own target compliance or can be sold to (other) parties …. “.

Model – White Certificates

F = denote cum. distribution of consumer types D (payback time)
I = indicator function
q = certificate price
$\underline{\Delta\eta}$ = conservation target
$\underline{\eta}$ = benchmark eff.
t = subsidy to consumer

$$\Delta\eta = \int_{\underline{D}}^{R} I_{\eta-\underline{\eta}} \left(\eta - \underline{\eta}\right) dF \geq \underline{\Delta\eta};$$

$$\max_{\{\eta(D),t(D),D\in[\underline{D},R]\}} \int_{\underline{D}}^{R} \left[q I_{\eta(D)-\underline{\eta}} \left(\eta\left(D\right) - \underline{\eta}\right) - t\left(D\right)\right] dF - q\underline{\Delta\eta};$$

IC $\quad U\left(D\right) := U\left(D, D\right) > U\left(\hat{D}, D\right) := Dw\left(\eta\left(\hat{D}\right)\right) - K\left(\eta\left(\hat{D}\right)\right) + t\left(\hat{D}\right);$

IR $\quad U\left(D\right) \geq U_0\left(D\right) := \max_{e,\eta} W = Dw\left(\eta_0\left(D\right)\right) - K\left(\eta_0\left(D\right)\right)$

This leads to an optimal control problem with a binding state constraint from IR

Lemmas

Lemma 1 *In the interior,* $\eta(D) > \max\left\{\underline{\eta}, \eta_0(D)\right\}$ *and* $U(D) > U_0(D)$, *the relaxed program*

$$\eta^r(D): \; q + (Dw' - K') = (R - D)\, w'. \tag{16}$$

characterizes the optimal prescription of efficiencies. Since $\eta^r(D)$ *has a singularity at* $R/2$, $D > R/2$ *is necessary but not sufficient for participating consumers.*

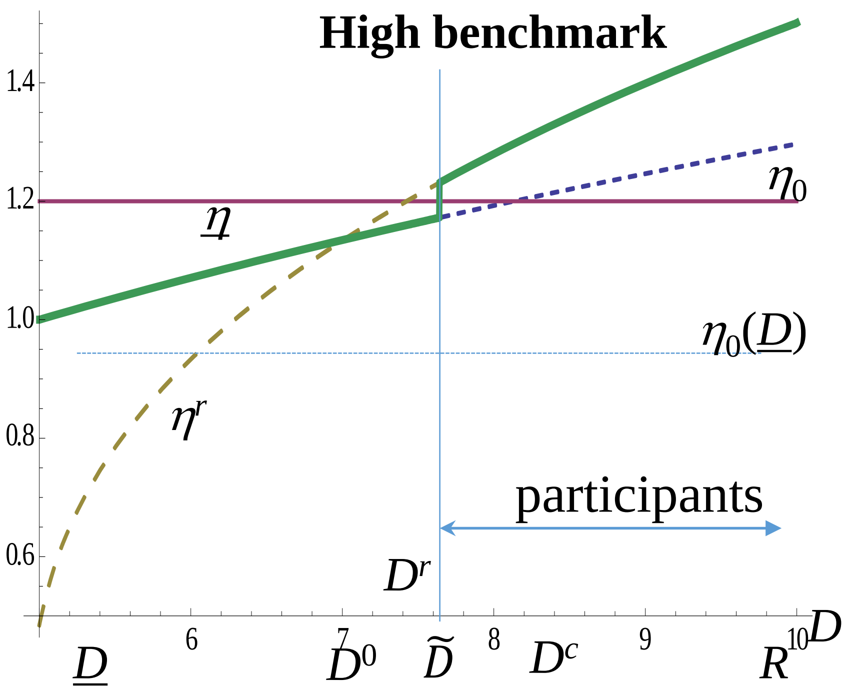
Lemma 2 *The consumer's own efficiency choice exceeds the relaxed program for low types, more precisely,* $\eta^0 > \eta^r$ *at least for* $D \to R/2$. *If the relaxed program* $\eta^r(D)$ *intersects the consumer's own choice* $\eta^0(D)$, *then from below and thus only once.*

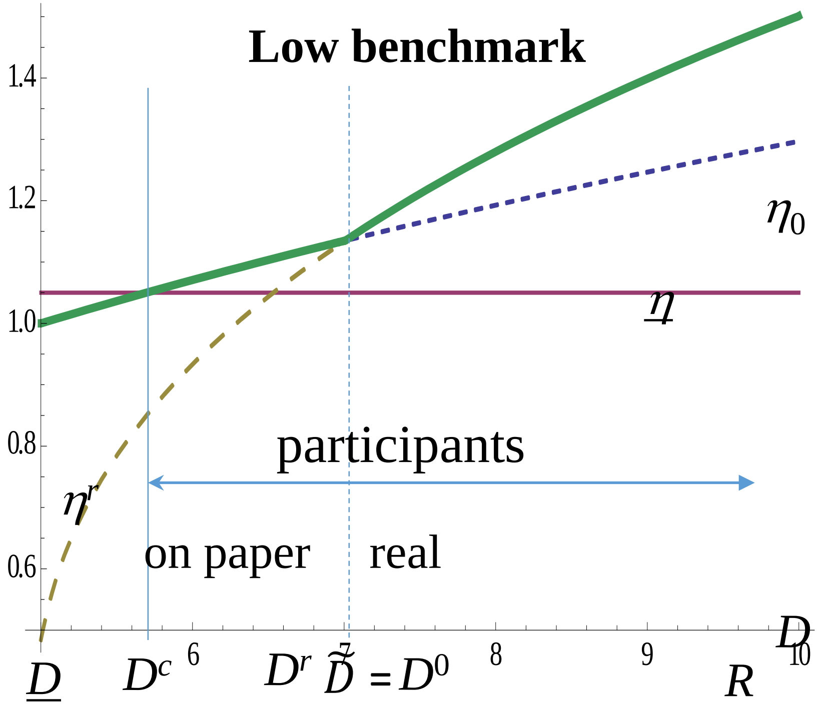
Optimal program

Proposition 1 *Given the permit price (or utility benefit) q per unit (incremental) efficiency and consumers having private information about their willingness to pay for efficiency due to different subjective discounting or planning horizons, the optimal utility conservation program is to induce consumers to upgrade their efficiency to the level implicitly characterized by*

$$w'(\eta) = \frac{K'(\eta) - q}{2D - R} < \frac{K'(\eta_0)}{D} = w'(\eta_0), \tag{31}$$

in the interior, i.e., $\eta > \max\left\{\eta^0, \underline{\eta}\right\}$. This excludes inefficient types, $D < R/2$, from the outset. Participation requires in addition to $D > R/2$ either a sufficiently large q or sufficiently efficient types ($\eta > \eta^0$ for $D \to R$ and any $q > 0$). The strictness of the benchmark determines how the pool of participants is chosen and whether the choice of efficiency is: (i) continuous given a relatively low benchmark ($\underline{\eta}$ such that $D^0 > D^r$), which allows to count conservation by consumers without actually inducing incremental conservation, or (ii) discontinuous given a relatively high benchmark ($D^0 < D^r$) such that efficiencies jump upward at the marginal type $\tilde{D} > D^0$.

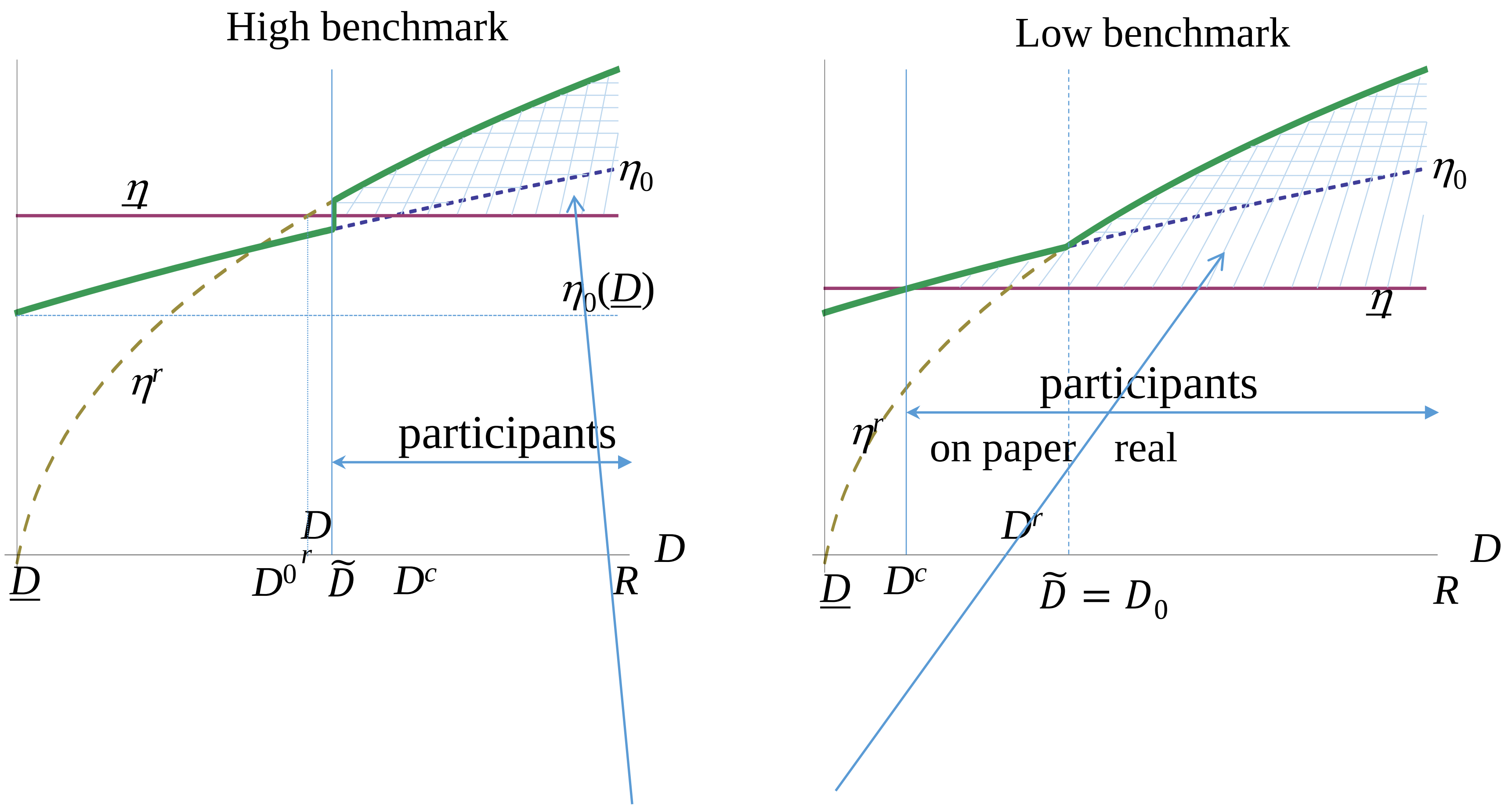




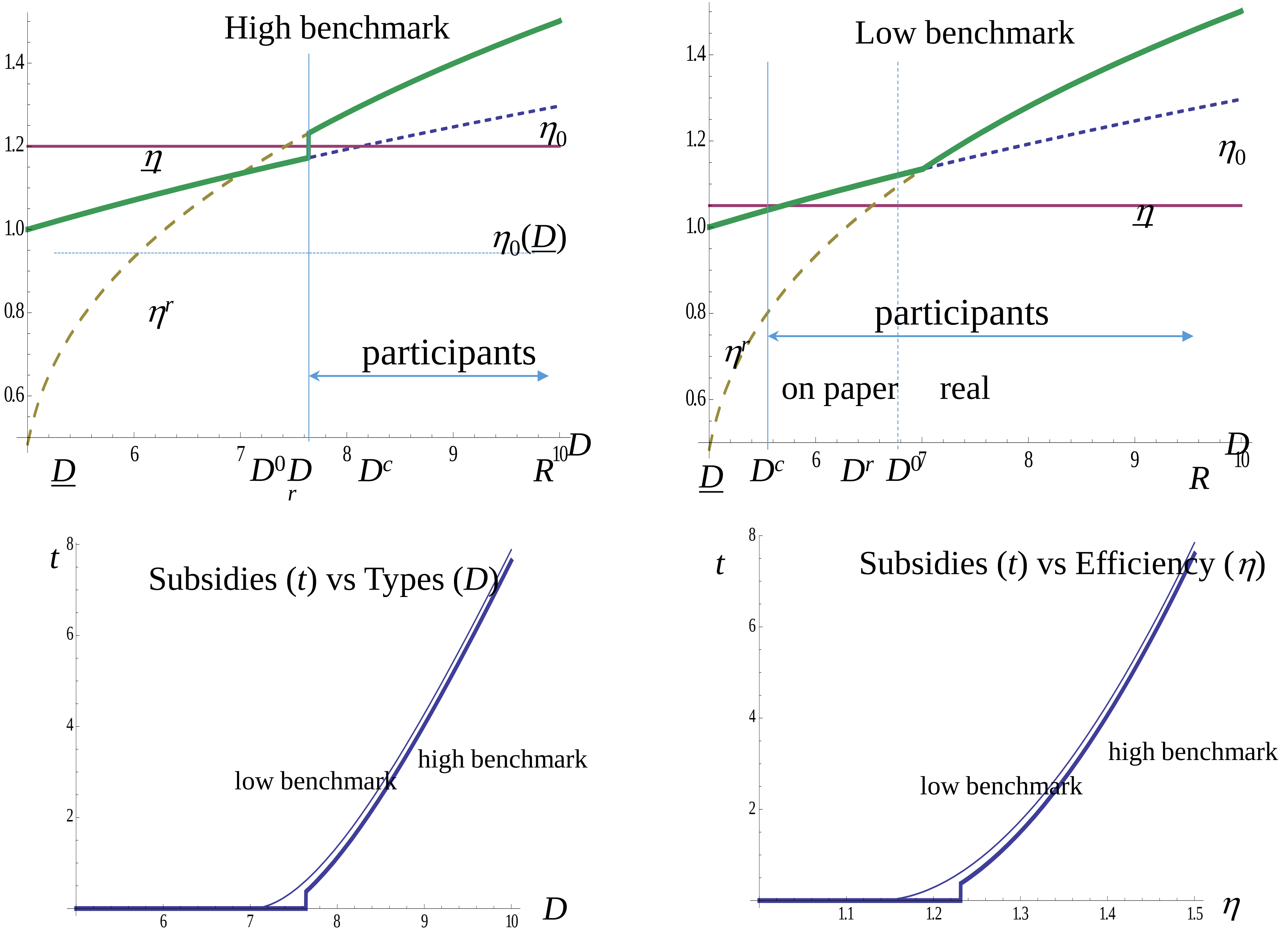
Paying for efficiency upgrades for D such that $\eta_0(D) < \eta^r(D) < \underline{\eta}$ cannot make economic sense, because the costly upgrade does not deliver permits. Hence, incentives are only offered for efficiencies above the benchmark and sufficiently above since $\eta^r(D) = \underline{\eta} + \varepsilon$, delivers only few permits but requires to pay for the large upgrade: $\eta^r(D) - \eta_0(D)$.

The consumer's own choice of efficiency exceeds the benchmark before the relaxed program cuts such that $\eta_0(D) > \underline{\eta} > \eta^r(D)$. This allows the utility to acquire permits for free (requires a token payment to register the consumers).

Conservation real and on paper



Conservation on paper only!



Subsidize efficient ('rich') but not inefficient ('poor') types!