Direct Taxation of Ship-based CO2 Emissions

Jack Devanney

Center for Tankship Excellence, djw1@c4tx.org

Sisyphus Beach

Tavernier, Florida

Last revision: 2011-05-20

1 Introduction

CTX has argued at length that the only effective, efficient, and safe alternative for reducing CO2 emissions from ocean shipping is a tax on CO2 emissions.[2] In particular we have argued that EEDI is just about the worst of all possible regulatory possibilities, wasteful in resources, unsafe, and in the sectors where slow-steaming is practiced including tankers, bulk carriers, and large containerships, totally ineffective.[1][3] In these sectors, EEDI will result in little, if any, reduction in CO2 emissions, over the market cycle. These arguments will not be repeated here.

But it is not enough to say that a tax is the way to go. It is incumbent on any tax proposal to lay out in some detail exactly what the regulation will look like, and how it wll be implemented and enforced. That is the purpose of this paper.

2 Taxing Bunkers

Up to now, all the proposals for taxing CO2 emissions of which CTX is aware do not tax CO2 directly. They are a tax on the CO2 content of bunker fuel oil (BFO). This focus on fuel is based on two assumptions:

1. A carbon content based bunkers tax is a near-perfect proxy for CO2 emissions, since removing and sequestering carbon on-board is not only not economic, it is next to impossible.
2. A tax on fuel will be much easier to implement and enforce than a tax on the actual emissions.

Assuming tanker owners don't turn cargo into fuel, (1) is almost true, now and for the foreseeable future.[1] But it turns out that (2) is just flat wrong.

Current BFO tax proposals envision either

a) collecting the tax at the ship level, or
b) collecting the tax at the bunker supplier level.

But so far no one to the CTX's knowledge has said exactly how this will be done. (The same thing is true of a bunkers based cap-and-trade which also needs to monitor fuel consumption by ship.) The reason that this has not been done is that it can't be done.

Either system ends of being dependent on the Delivery Ticket, that is, the paperwork that documents the transfer of bunkers from the bunker supplier to the ship. Under either system, both buyer and seller have a huge incentive to produce paperwork that under-states the amount of bunkers transferred. Assuming a $50 per CO2 ton bunkers tax, the tax bill on a single 5000 ton VLCC bunkering, will be about $750,000. The opportunity for collusion is inescapable. To prevent this would require incorruptible, fearless third party inspectors at every bunkering. And their bosses and bosses bosses would have to be equally incorruptible and fearless. Even if one deployed such an army of saints, the system would easily be evaded by clandestine bunkerings.

This saintly army would have to have the strong support of the local legal system despite the fact that the bunkering country has less than nothing to gain from collecting the tax. If a bunkering country made such strenuous and valiant efforts to prevent collusion that it was successful, it would simply move bunkering to a less vigilant nation, which raises the obvious question of why would even the most honest country enforce a tax which it is not going to receive only to push its bunkering business elsewhere.[2]

Every time the system challenged the accuracy of a Delivery Ticket, there would have to be an investigation, claims and counter-claims, and often some sort of court case. At this point administrative costs skyrocket.

Gresham's Law would quickly force any honest owners and any honest BFO suppliers out of business. The amounts of money at stake are so large that the corruption will extend to the highest levels in all but the wealthiest countries. The IMO estimates that international shipping emitted 870 million tons of CO2 in 2007.[4] A $50 per ton CO2 tax represents over 40 billion dollars a year of economic rent, just waiting to be pounced on.

[1] See footnote on cylinder lube oil, next page.

[2] In mid-1991 California imposed an 8% sales tax on international bunkering done in California ports. At the time this was about $10 per ton. Bunkers sales fell about 50% almost immediately and the state rescinded the tax in late 1992, despite the fact that it was the recipient of the proceeds.

One can imagine attempting a layer or two of multi-national checks on top of such a system, but such checks will be too far removed from the actual transactions to have any impact; and, if they did, they would become stranded on the reef of national sovereignty.

Given the ability of bunkering to move to the most "attractive" jurisdiction, — or no jurisdiction at all by going far enough offshore — ***enforcing a bunker tax on international shipping is simply not feasible.*** This is the reason international bunkers are currently tax exempt.

3 Monitoring Stack Gas Emissions

Mark Twain is supposed to have said "It's not what we don't know that's the problem. It's what we know that ain't so."[3] Regulators have assumed that monitoring ship stack CO2 emissions in not feasible, or at least not economically feasible.

In fact, CO2 stack emissions can be monitored to an accuracy of better than +/-2% in a reliable, tamper-proof, difficult to spoof manner for about $60,000 per ship. And as a bonus, we can throw in a direct, encrypted transfer of the data via satellite to a central processing entity.

Stack gas flows and composition are being measured all over the world. It is multi-hundred million dollar business. Beginning January, 2010, the USA EPA required 4,674 American installations to continuously monitor CO2 emissions.[4] This GHG program builds on the Acid Rain Program (ARP) which has required continuous monitoring of stack SO2 since 2000 or earlier.

There are several highly competitive technologies for doing this. I will mention just one as an example. We need both total gas volume and the CO2 concentration of the gas.

1. Measure volumetric flow by ultra-sonic pulses. This works by measuring the difference in travel time of sound pulses sent downstream and upstream in the stack. These systems cost about $10,000. The system is actually measuring gas flow velocity along the path of the beam and is accurate to 0.1 m/s. A typical ship stack velocity is 30 m/s, so we are talking +/-0.3%.
2. Measure CO2 concentration via absorption spectroscopy. This system uses a laser to project a beam across the stack. The frequency of the beam is tuned to an absorption line of the gas of interest. The received signal is analyzed for strength and line shape. Since the bandwidth of the beam is very narrow, only the gas of interest is picked up. Accuracy is better than 2% of reading. These systems cost about $35,000. One analysis box can support multiple beams (typically four). (Sulfur and NOx control regimes could piggyback on the CO2 system by simply adding two more laser modules to the analyzer.
3. The data would be collected in a sealed computer, and periodically (say once a day) transmitted directly to a central processing entity, presumably IMO, via satellite. Cost of the data storage and communication device, less than $5000, assuming we use the ship's Satcom system. There is no reason not to as long as the message is properly encrypted and electronically signed.[5]

All this equipment is off-the-shelf. They are type approved not by a compliant, vendor-paid, Classification Society, but by real regulatory bodies such as the USA's EPA, Germany's TUV, and the British MCERTS. All that's required is a bit of application specific software, most of which is already available.

There are several points to be made about such a system:

No by-pass First and foremost, the system is extremely difficult to by-pass. By-passing an engine fuel flow meter or a bunkers transfer gage is child's play.[6] And the evidence of such by-passing can be cleaned up in a matter of minutes. But a VLCC will generate

[3] Actually Twain probably never said this. The quote is more properly attributed to a competitor, Josh Billings, demonstrating the accuracy of the aphorism.

[4] Regulatory Impact Analysis for the Mandatory Reporting of GHG Emissions, Final Rule. These plants extend down to 25 MW thermal ***input***, about the size of a Aframax tanker power plant. The EPA estimates the cost of the hardware to do this at $44,403 plus about $8,000 for installation (Table 4.2a).

[5] A dedicated satcom would add less than $10,000 to the cost of the system.

[6] For two stroke engines, the bunkers based systems and EEDI create an automatic by-pass of cylinder lube oil emissions. For a two stroke engine, about 1% of the stack gas CO2 results from the combustion of cylinder oil. 1% may not sound like much, but what these systems do is set up a significant bias against 4-stroke and in favor of 2-stroke.

up to 300,000 m3/h of stack gas. By-passing even a modest portion of this flow will require major modifications of the ship's exhaust system, which would be very difficult to hide from port state inspectors. The modifications would require the connivance of a large part of the crew, exposing the owner to whistle-blower risks. Right now it is the whistle-blowers that the owners fear most. This system involves the crew in a way that playing paper-work games does not.

No paperwork The data goes direct to the IMO. There is no dependence on the ship or the bunker supplier or any third party inspector or a contra-motivated bunkering nation. There will be no forgery, for there is no paper to forge.[7]

Nearly tamper-proof Once the data is collected it is nearly impossible for the ship to change it. The data would not only be in a sealed black-box, but it would be immediately check-summed and encrypted. If someone were able to break into the emissions computer, no one other than the software designers would know how to take advantage of the break-in. And any attempt to break into this box would send an alarm to IMO and expose the ship to special inspections and fines.[8]

Difficult to spoof There are no moving parts, no sample extraction system whose tubes might be "re-directed". Whatever the would be spoofer attempts to do, it has to be done in the middle of a hot stack. The crew would have to be involved. It has to affect the whole beam.[9] And it can't interfere with the beams in a manner the system can detect. Furthermore, both the ultrasonic sensors and the laser are set up to send an alarm if someone attempts to fiddle with them. or even generates a clearly anomalous signal. The probes themselves would be sealed to the stack, both physically and electronically, so any attempt to remove them would set up off alarms, and result in broken seals.[10] The seals, and in fact the whole system, will be able to take advantage of the extensive work IAEA has done in making their nuclear materials monitoring process robust and tamper proof. The IAEA has developed at least three kinds of electronic and fiberoptic seals: VACOSS, IRES and EOSS.

The cost of enforcement is almost in the noise. Assuming a $50 per ton CO2 tax, a $60,000 package would be paid for with 400 tons of fuel burn, four full-power steaming days for a VLCC.[11] If a system alarmed, we will need inspectors to go on-board and find out what happened, but this will be an exceptional case. If a system stopped reading or the readings are anomalous, the ship would be charged an amount that is a generous upper bound on what she could have emitted during the period the system is down or malfunctioning, as the ARP program does now. Thus, the owner will be strongly motivated to keep the system well maintained.

In short, ***monitoring of ship-based CO2 emissions is not only feasible, it is cheap.***[12] Most importantly, there is no opportunity for collusion between the people that are supposed to be collecting the tax, and those that are supposed to be paying it.

4 Using the Data

The next question is: how should the emissions data we have collected at IMO be used? CTX thinks the answer is obvious: charge the polluter for his pollution. Send the shipowner a bill for his emissions. This is discussed in some detail in the next section. However, this is not the only possible use. The emissions data could be used:

[7] At least not before the data gets to the IMO. IMO will have to enforce the honesty of the data collection staff in much the same way a national mint enforces honesty on the people who print the money. But we are talking about a handful of people in a tightly controlled environment.

[8] By the same token anyone who attempted to switch out the emissions computer for another designed to send false signals to the IMO would need to know the code.

[9] One could imagine for example some kind of barrier or deflector just upstream from the sonic beam path which would slow the gas flow along the path. But such a barrier would have to be large, robust piece of structure, easily detected in a number of ways.

[10] The data would be automatically audited upon receipt at the IMO, for alarms, malfunctions, and simply suspicious numbers. Once again the program can learn from the successful ARP procedures.

[11] In fact, the system could be given to the owners.

[12] The system could be economically installed on ships that burn as little as 2 TPD of fuel (400 kW). At $50/t CO2, the payback on such a ship (boat?) would be about a half a year. Since the data collection is fully automated, the marginal administration cost of adding another ship to the database is negligible.

As a check on a bunkers tax based system If we stubbornly stick with a bunkers based tax, stack gas monitoring could make the system work. If the stack emissions did not match the Delivery Ticket claims, then an investigation and presumably fines, etc would follow. CTX think this is a needless, inefficient, costly, messy complication of a direct emissions tax. But it could be done.

To enforce a cap-and-trade system CTX has argued strongly in favor of a tax over a emissions permit trading system. But if we were to impose an ETS rather than a tax, it should be done via stack gas data, not bunkers purchases. And an ETS, for all its faults, is vastly superior to command and control legislation, especially EEDI.

To enforce mandated standards Last and least, the system could be used to enforce arbitrary standards. Such regulation is bound to be inefficient, full of loop holes, biases, and unintended consequences, and prone to all kinds of political influences.[13] It flies in the face of all we know about intelligent regulation. It is the wrong thing to do. But it could be done.

5 A Direct Emissions Tax

For all the reasons discussed in [2] not to mention 100 years of economics literature, CTX believes that the obvious use of the emissions data is a direct tax. Once a month the central data processing entity, which for now I will assume is IMO, would send the owner a bill for his emissions.

This raises a number of implementation issues, which must be addressed:

Price What should the level of the tax be? Economic theory tells us that the price of a ton of CO2 injected into the atmosphere (regardless of source) should be the marginal social cost of that ton of CO2.[14] Unfortunately, no one knows what that is. Current prices range from about $15 per ton (EU ETS permit price) to about $150 per ton (Swedish carbon tax) IMO will have to make a guess. CTX recommends starting out on the low side, say $25 to $50 per ton CO2, with the intention of probably increasing the tax in the future.

What's important in CTX's view is that, whatever the tax is, it be fixed for at least 4 years. This is required to give the owners the certainty they need to make long-term investments in CO2 reducing technology. Every 4 years IMO would meet to discuss adjusting the price. Ideally, over time the international shipping tax would follow similar CO2 taxes/prices in other sectors.

Getting Paid Sending out an invoice is not the same as actually collecting the tax. Very large sums will be at stake. Owners have the ability to magically disappear and re-appear in another corporate guise; and IMO has no police power. To control this the tax must be levied on the ship. In the event of non-payment, IMO would send out an alert to the flag state and the port states who are party to the Convention. If the money is not forthcoming in a reasonable amount of time (with interest), the port states would be empowered to detain the ship, until the monies are paid. Failing such payments, the ship would be auctioned off to pay the claims.[15] ***As long as the bulk of the major port states detained ships for non-payment***, any non-paying owner would either lose his ship or be forced off all the world's major trade routes. The key is the port states.

However, the flag states should have an obligation as well. Flag states which tolerated non-paying ship owners would be black-listed by the port states supporting the legislation. This would force flag states to either enforce the tax, or be relegated to ships that could trade only in the back-waters.

[13] The most basic unintended consequence of EEDI is that it won't reduce CO2 emissions, at least not from sectors where slow-steaming is practiced, which includes tankers, bulk carriers, and big containerships.[3]

[14] Once we have internalized the cost to society of emitting a ton of CO2 by imposing a tax equal to the social cost of the most expensive ton of pollution, ***our job is to do nothing else***. Just sit back and let the market go to work. Mandatory requirements that happen to be efficient given this tax will have no effect since the shipowners will adopt them automatically. Any inefficient requirement won't be adopted which is exactly what we want. In other words, once the proper tax is in place, any mandated requirement is either unnecessary or bad for society. EEDI falls into the latter category.[1]

[15] At any given time, at most three or four months of the tax will be at risk. Any ship that is worth less than four months of her CO2 tax should be pulled off the water and scrapped.

Term Charters There is a potential problem associated with taxing the ship. When a ship is term chartered, the term charterer becomes the effective owner. He has control over what bunkers are purchased, where the ship goes and how fast, in other words, how much CO2 the ship produces. For the system to work, the term charterer, not the owner, must end up being charged the cost of his pollution. This will require reasonably minor changes in the term charter contracts (known as charter parties). All that is needed is a charter party clause that makes the term charterer explicitly responsible for the ship's CO2 emissions as billed by IMO during the duration of the charter.[16] IMO will still bill the ship, but the owner becomes a pass-through. The owner will still have to collect from the charterer but this is an age old problem, and the owner has a number of weapons at his disposal, including withholding discharge in the event of non-payment.

The whole concept of a pass-through is not new. Some port charges and canal tolls are currently handled this way. In fact, a whole body of law called a maritime lien has developed around the concept of making the ship responsible for non-payment of charterer expenses. Nonetheless the enabling legislation must make explicit the owner's right to require repayment of the CO2 tax from a term charterer (and sub-charterers). It's little different that asking a landlord to collect an electricity bill from a tenant.

6 The Scramble for the Rent

The final 40 billion dollar a year question is: where should the money go? This is a political issue faced by any system that puts a value on a public good. And it is an issue into which CTX will not venture very far. We will say only that the proceeds should be divied up in a way that:

Makes the tax politically feasible Unless the tax is enacted, the whole exercise is pointless. This probably means that a portion of the proceeds has to go to the flag states.

Does not compromise the price mechanism This would occur, for example, if the flag states, competing for owners, rebated a portion of the tax revenues to their owners. This would seem obvious, but apparently it was not to the designers of the EU ETS system, which gives away valuable permits on the basis of past pollution, thereby destroying a portion of the incentive to reduce emissions which reduction would cost the polluter some of next year's allocation.[17]

The second requirement implies that the proceeds to the flag states ***cannot*** depend on the size of the flag's fleet.

The most developed of the distribution proposals is the IUCN's Rebate Mechanism (RM) system which is keyed on the value of developing country imports. (MEPC 60/4/55 and 61/5/33). This is an attempt to reconcile a flag agnostic tax with Kyoto's "common but differentiated responsibilities". Under this proposal, the net revenue after rebates would all come from developed country exporters and importers. So we are talking about a 40 billion dollar a year transfer from developed countries to developing countries; but in way that does not distort the tax.

Since the largest flag states are developing countries, it would be in their interest to vote for such a tax. For example, under the RM proposal, Panama's share of 40 billion dollars per year would be 26 million.

7 Conclusions

1. A carbon tax for international shipping based on tracking bunker fuel purchases cannot be feasibly implemented and enforced. This conclusion hold a fortiori for a bunkers based cap-and-trade.

[16] Net of any penalties due to system malfunction.

[17] The shows up most vividly in the new entrant and closure context. New CO2 emitting plants are given valuable permits for free, but a new nuclear plant that produces nil CO2 is not. Similarly an old, inefficient CO2 belcher has a strong inducement not to shut down and lose its permits. The perverse incentives are obvious.

2. A carbon tax based on direct stack measurement of CO2 emissions is not only feasible, it is cheap, and it would be far, far more difficult to evade than a bunkers based scheme.[18]

Possible Wording of Additional term Charter Party Clause

a) Owners shall continue to be responsible for promptly paying the IMO Ship Emissions Tax (SET) to the SET Treasury (SETT) throughout the period of this charter.

b) Excluding off-hire periods, charterers shall be responsible for reimbursing the owner for his SET payments for the period of the charter, provided the Emission Monitoring Package (EMP) is functioning properly according to the SETT. During on-hire periods in which the EMP is not working properly according to the SETT Charterers shall be responsible for reimbursing Owners __% of the SET imposed during said periods.[19]

c) Upon making a valid SET payment to the SETT, Owners shall invoice Charterers for Charterers' portion of the payment presenting both the SET invoice(s) and the official SETT receipt(s) of payment to Charterers.
If Charterers wish to contest this invoice, they shall within ten days of its receipt appeal to the SETT stating their claim of the amount Charterers owe and why. Otherwise Charterers shall pay Owners the amount invoiced within 30 days.

d) Within ten days of receipt of Charterers appeal, the SETT appeal board will rule on the amount owed. Charterers shall pay this amount to Owners within 20 days of the receipt of Charterers appeal.

e) Owners shall have a lien upon all cargoes and all sub-hires, freights, sub-freights and demurrage for any amounts due under this clause.

f) Nothing in this clause shall preclude Charterers from subsequently claiming reimbursement for payments made under this clause which would not have been made had the ship met the speed-consumption guarantees of Clause [Spd-fuel] or by appealing the SETT appeal board ruling. Such appeals and claims shall be made according to Clause [Law and Litigation].

References

[1] J. Devanney. Eedi, a case study in indirect regulation of co2 pollution. Technical report, Center for Tankship Excellence, 2010.

[2] J. Devanney. Efficient, safe reduction of co2 emissions from shipping. Technical report, Center for Tankship Excellence, 2010.

[3] J. Devanney. The impact of eedi on vlcc design and co2 emissions. Technical report, Center for Tankship Excellence, 2010.

[4] Marintek et al. Second imo ghg study 2009. Technical report, IMO, 2009. MEPC 59/24/Add. 1.

[18] It has been reported that in some countries a BFO tax collected domestically and then sent to a foreign entity is illegal and would require re-writing some legislation. A stack gas based system requires no domestic collection effort.

[19] Charterer percentage should depend on how tax is computed during periods in which EMP is not working. Suppose SETT guesses fuel consumption based on the engine consumption at MCR. Then if might be reasonable to charge the charterer say 50% on the grounds that the actual power is unlikely to be less than 50% MCR..