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Border Carbon Adjustments without Full (or Any) Carbon Pricing

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1. Introduction

Border carbon adjustments (BCAs) are national or possibly multicountry trade measures—typically taxes on imports (and sometimes rebates on exports)—intended to support ambitious national climate mitigation policies. They are meant to address part of the problem that ambitious mitigation policies in one jurisdiction can lead to increased emissions in jurisdictions with less ambitious policies ("leakage"). In particular, they address the portion of leakage associated with energy-intensive production moving from areas with more ambitious policies to those with weaker policies ("competitiveness"). BCAs are being discussed as part of broader carbon pricing policies, like the European Union's Emissions Trading Scheme (EU ETS), which recently put forward a concrete BCA proposal; they have also been described and modeled alongside a domestic carbon tax. Much has been written about the design of a BCA in this world with what we might call "full" carbon pricing.

Yet, nations' climate mitigation policies may or may not include carbon pricing, and when they do, the carbon pricing is often not comprehensive. In the United States, for example, carbon pricing has been implemented at the state level (California, Washington State, and the northeastern states' Regional Greenhouse Gas Initiative) but is currently a lower priority in national policy than incentives and regulatory standards. China has implemented an ETS that allocates free allowances based on performance benchmarks like a firm's production level of electricity or (in the future) other industrial products. That is, the policy might regulate tons of CO_2 per megawatt of electricity, per ton of steel produced, or per ton of cement. This is frequently referred to as a tradable performance standard (TPS; see Pizer and Zhang 2018). Even the EU ETS gives significant free allocation to energy-intensive, trade-exposed industries, thereby blunting some of the ETS effects. This raises the question of how a BCA might work with a "partial-price" or "nonprice" policy.

In this paper, we talk about "partial" price policy as implementing an explicit carbon price that is paid on some, but not all of a firm's actual emissions. Perhaps there is a free allocation tied, one way or another, to production of a given product. This might be explicit, through a tradable performance standard or output-based allocation, or implicit, through a free allocation that helps address competitiveness effects.

We talk about a "nonprice" policy as regulating emissions through some type of non-tradable technical or performance-based standard; there is no observed price. Although it is possible to estimate an *implicit* price or marginal cost associated with the most recent (most expensive) ton of carbon dioxide reduced, it is not observed *explicitly*.

In this short paper we outline basic principles of how such partial-price or nonprice policies might equivalently be applied to imports as a BCA. Full carbon-pricing policies (auctioned ETS credits or a carbon tax) typically put an equivalent price on the carbon content of imports, usually with an adjustment for any carbon pricing in the country of origin. In contrast, partial-price or nonprice policies exempt a portion of the carbon content of imported goods before applying any price. Moreover, the price paid on

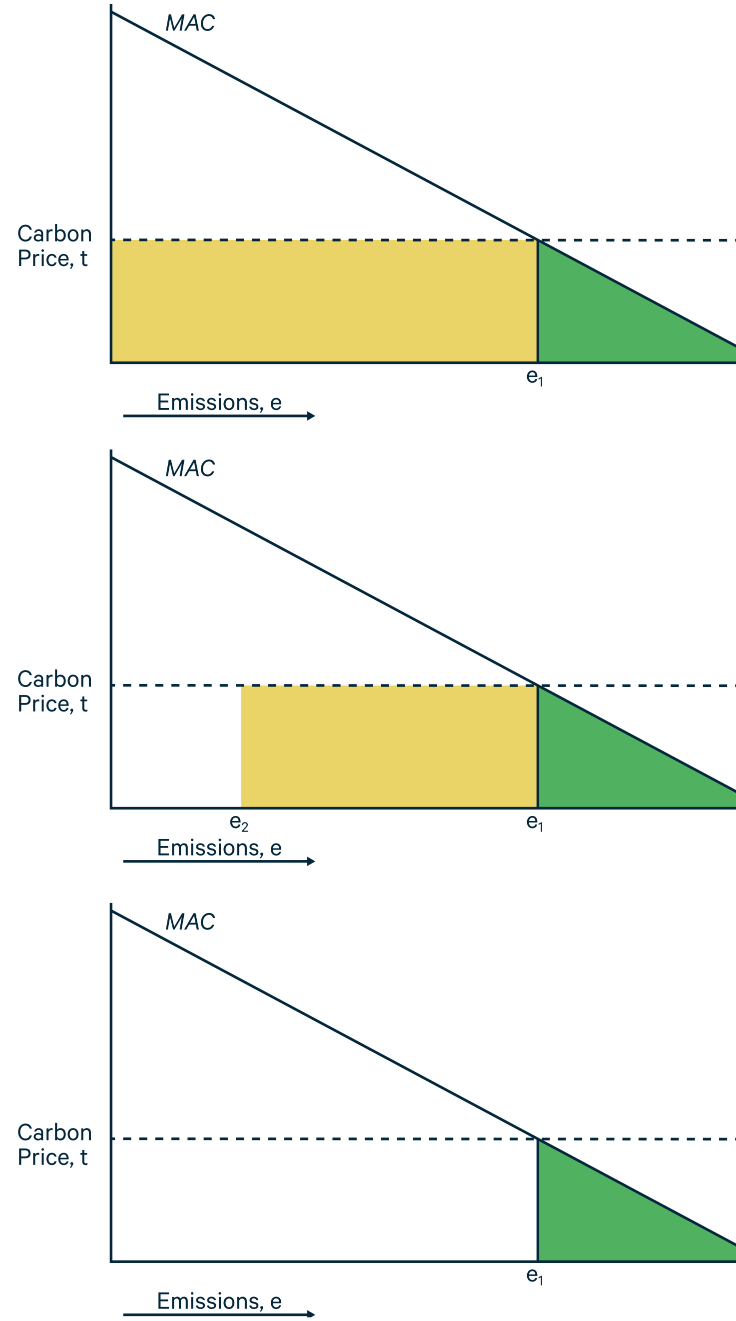
not observed. That is, it should be based on the cost of the last
lly, not the average cost.

is an economic notion of roughly equivalent treatment. That
egulated market facing the same incentives and charges, on
c producer? "On average" is a critical term. Unless there is
tional climate policy that is easily replicated on imports, the
even local-) level regulation means different producers will likely
es and costs. Even with national regulation under the Clean Air
some discretion in their implementation. Or a national regulation
nce to the starting point of individual firms in the application
hoice of how to match a range of observed a range of domestic
es to BCA parameters has consequences that might motivate
ow end of observed values instead of the average.

that we are also ignoring issues of WTO compatibility. This has
here at length for full-price policies (Hillman 2013; Howse 2021).
cially nonprice policies raise even more issues as the treatment
mpting to mimic domestic policy incentives and costs, is not the
no explicit domestic charges even as BCAs are implemented as a
for future work.

her design questions, including treatment of exports,
sions, scope (e.g., are indirect emissions targeted?), types of
use of revenue. There is also the question of BCAs' fairness with
and emerging economies. We believe these questions apply
there are full-, partial-, or non-price domestic policies and we do
them here (see, e.g., Marcu, Mehling, and Cosbey 2020). Rather,
view the costs imposed by full-, partial-, and nonprice policies and
As in the context of full-price domestic policies. This frames our
ying to apply equivalent treatment to imports. We then discuss
equivalent treatment with a partial-price or nonprice policy
pplied with full-price policies. Finally, we consider how domestic
one other, and how BCAs might account for a trade partner's
icies.

Figure 1. Emissions and Costs under Carbon Prici



The figure diagrams policy costs for a firm where e_0 is the baseline emis
output and e_1 is the chosen level of emission in response to a particular p
full-price policy, e.g., a carbon tax or ETS with auctioned permits. Panel
policy (e.g., a tradable performance standard equal to e_2 or an ETS bencl
Panel c shows a nonprice policy with emissions rate e_1. Green indicates a

particular firm. Figure 1 plots emissions along the horizontal axis,
baseline emissions rate e_0 per unit of production.[1] This is the
xide emitted, for example, per ton of steel produced, before any
duce emissions under a climate policy (whether carbon pricing
o indicate the marginal abatement cost (MAC) along the vertical
ule indicates, at each level of emissions on the horizontal axis, the
more ton along the vertical. Intuitively, as the firm reduces more
st of an additional ton becomes higher: the first ton is cheap, the
For that reason, it rises from right to left as we move from the
vel, e_0, toward zero emissions. If we had plotted abatement rather
the horizontal axis, the MAC would rise from left to right.

ses that lead to the same level of emissions, e_1, and abatement, e_1
epresenting (a) full carbon pricing (an auctioned ETS or carbon
n pricing (an ETS with free allocation or a TPS); and (c) nonprice
we assume all three cases lead to the same level of abatement for
e the same total cost of abatement, indicated by the green area.
he cost (the vertical distance) of each ton abated (a horizontal
aseline emissions level e_0 to the final emissions level e_1, it equals

iangle indicates the direct abatement costs of the tons *avoided*,
price that firms may pay for the tons that *occur* (sometimes
ied carbon"). Firms facing full carbon pricing at price *t* in Figure
ETS or a tax, pay that price *t* on the full amount of emissions that
ated by the yellow rectangle in panel (a). Note that in facing the
re exactly abating all the tons whose abatement is cheaper than
although the abatement cost could be larger than the embodied
rticular, at high levels of abatement—we have drawn it such that
ons cost with full pricing is much larger than the abatement cost.

rice or nonprice policies pay the price *t* on only a smaller volume
nel (b), or not at all, as in panel (c). Consider, for example, a
es firms to limit their emissions to e_1—without exception—but
ssions e_1 to occur without any further charge. We might think of
missions standard. Firms face the costs associated with the green
s no payment equivalent to the yellow area, as indicated in Figure

r a tradable performance standard that limits emissions per
average, for all firms in the sector to the standard e_2, indicated
s per unit produced up to e_2 are unpriced. Firms that beat the
nces that can be sold to firms that miss the standard; here we
ice is *t*. In our example e_1, the actual emissions level for our
than the emissions standard for the sector e_2, so the firm will

in the market. Note that, on average, firms in the market have to
only allowances bought by a firm above the standard come from s
earned them by beating the standard.

Now suppose there is free allocation up to a benchmark of e_2. Firm
up to the allocation e_2. Indeed, they can sell excess allowances in t
missing the standard, they have to buy allowances—for the examp

Finally, while we have not drawn this case, imagine reductions to e
of government policies that provide financial incentives to reduce
benchmark e_2 might lie to the *right* of e_1. This would also be the c
were in excess of the observed emission level.

The preceding discussion highlights similarities and distinctions b
price and nonprice policies. Partial-price policies can face nonaba
yellow rectangle in Figure 1b; nonprice policies do not. Partial-pric
an observable price; nonprice policies do not. Under partial-price
particular emissions level leads to a rebate—if firms beat the stan
they can earn money by selling allowances; nonprice policies do n
benefits.

In contrast, a full-price policy, such as an auctioned ETS or carbon
all embodied emissions. Both nonprice and partial-price policies e
of emissions from such pricing. Moreover, both nonprice and parti
involve additional heterogeneity in this exemption: firms in differe
different historical emissions could face different levels of allowed
benchmarks, or different free allocation.

2 Here and throughout, we somewhat loosely talk about a partial-p
benchmark, exemption, or standard. All of these refer to the same
emissions below which there is effectively no charge on the emiss

tion, a BCA that charges an identical import levy *t* on the actual
xide emissions of foreign production will roughly mimic both the
ves of the domestic policy. Suppose a trade partner has no climate
firms, foreign firms will have an incentive—on their exports to this
to the point where their MAC equals *t*. Like domestic firms, these
pay the levy on all their remaining emissions associated with
arket. If the foreign MAC were the same as the domestic MAC in
uld equal the yellow and green areas in Figure 1a.

pt glosses over many detailed design questions that need to be
m how to measure the embodied carbon of imported goods and
s (versus imports), to whether the policy complies with WTO rules
trade partners at different levels of development equitably. The
here is how a BCA might adjust for comparable action among
nsider full-price policies first.

instead of no climate policy, a trade partner has its own carbon
sent some BCA, foreign firms will not face as high an incentive
ir embodied carbon as domestic firms. But charging the full
e carbon content of imported goods would be too much. Foreign
centive and total per ton charge of $t + t'$ on their exports to this
uld make sense to set the BCA levy for this partner equal to $t - t'$.
r's own domestic price, t', the full burden is *t* on its exports to this

of BCAs in a world with an ETS or a carbon tax: seek to have
ce the same incentives and charges as domestic producers.
y, apply the full domestic price; with a nonzero foreign price
tic price, apply the difference. This remains the guiding principle
rice and nonprice policies.

Nonprice Policies

Here we consider the incentives and costs created domestically b
nonprice climate policy and then design a BCA to create similar in
for foreign firms exporting to this country. Based on the preceding
examples in Figure 1b and 1c, the basic idea is (1) to exempt a cert
per unit of production and (2) to charge a price for emissions over

In the partial-price policy, diagramed in Figure 1b, with a well-defin
exemption level e_2 per unit of production and an observed price *t*,
straightforward. Charge a price *t* on the carbon content of imports
benchmark level e_2 per unit. The only complication is if the exemp
varies across domestic firms. One could then use the average pric
benchmark across domestic firms to define the exemption and pr
imports.

Conceptually, we imagine imports facing the US market collective
want to treat imported goods the same based on the average dom
Put another way, we might imagine trying to come up with a comm
and carbon price that, if applied equally to all domestic firms, wou
effect on market price and carbon emissions as the actual distribu
exemptions. When treatment of domestic firms varies, applying th
exemption level and price to imports will be more favorable than t
some domestic firms, and less favorable than that of others. Depe
structure of import competition within the sector and how one we
for different firms and importers, one could make the case for exe
anywhere within the range of observed domestic firm-level values

Larger questions loom with nonprice policies, depicted in Figure 1
should a country ban or tax imports that have higher embodied ca
products? If a domestic regulation clearly establishes a maximum
rate, a ban would seem plausible if not reasonable. The solution is
instead, there is a distribution of emissions rates because of dome
Is there really a maximum allowable rate (for example, the maximu
should imports above said rate really be banned?

Analogous to the conceptual approach with partial-price policies
benchmarks vary, a logical solution would be to treat domestic pro
Apply the average domestic emissions rate as an exempted emiss
Figure 1b) and then price the excess emissions at the average mar
domestic producers (*t* in Figure 1b)—that is, the average (across f
reduce the last (most expensive) ton of abated carbon dioxide em

Here, we bump into the particularly tricky issue with nonprice poli

lysis of domestic regulation. Statistical techniques might be used
costs. Some regulations may have fines or other consequences
t could be used to assess the incentive faced on the last ton
one could turn to the government's social cost of carbon, the
ed to emissions reductions in regulatory impact analyses. The
s: BCAs for partial-price and nonprice policies should be designed
ed level of embodied content based on domestic emissions that
icing; and (2) a per ton charge on emissions above that exempted
rginal cost associated with domestic above-exemption emissions.

climate policies with partial- a
price policies?

Above, we discussed the case of a foreign carbon price that was e
comprehensive but lower than the domestic price. We now want t
general case of intersecting foreign and domestic policies.

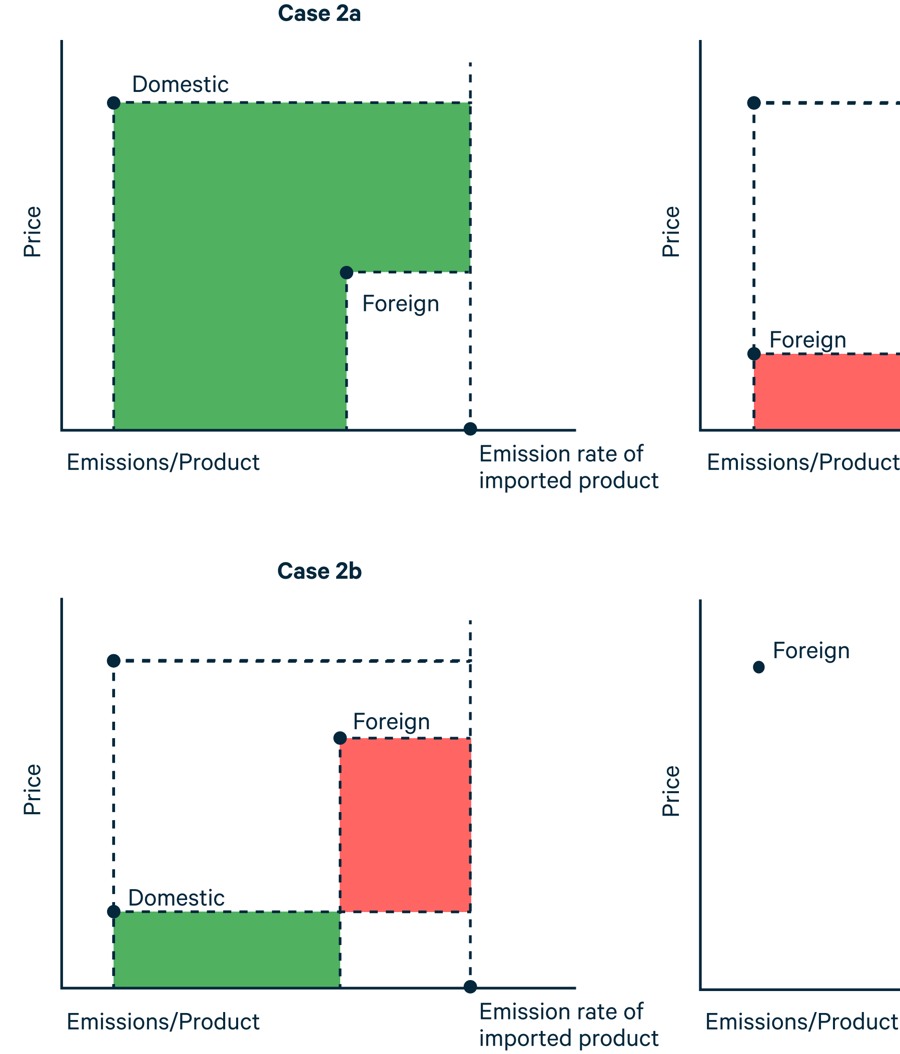
Countries may have a combination of overlapping price and nonp
policies in different sectors across different subnational regions. U
be possible to convert this landscape into (1) an average of obser
per unit of product across firms (value for e_1 in Figure 1); (2) an av
associated with observed emissions rates (value for t in Figure 1);
exemption relative to pricing the full amount of average observed
full marginal cost emissions rate t (value for e_2 in Figure 1c). A zer
indicate that firms are paying the full marginal cost t on all emissi
equivalent to the yellow rectangle in Figure 1a. This would likely b
carbon tax or auctioned permit system but no other policies. Othe
policies are likely to cause some discrepancy between the margin
the other policies) and any price paid on unavoided emissions. Th
e_2/e_1, therefore could arise *either* because not all emissions face a
or because the emissions price is less than the actual marginal co
actual cost of unavoided emissions is given by the (smaller than i
rectangle in Figure 1b.

Table 1 shows various combinations of domestic and foreign clima
intersecting with one another and possible BCA approaches. We h
considered the case where countries have either full-price policie
This is described in the upper left corner. The remainder of the ta
consideration of nonprice policies actually adds four new "BCA ca
discuss. (When the domestic importer has no policy, we assume b
inappropriate.)

These four cases can be divided in two groups. What happens wh
a partial-price or nonprice policy and the trade partner has either
partial-price or nonprice policy (cases 1 and 2), and what happens
has a full-price policy and the other has a partial-price or nonpric
and 4). Case 1 is described in the previous section. The domestic
can be used to define an emissions rate e_2 that serves as a bench
emissions and a price t applied to emissions above the benchmar
where a maximum emissions rate regulation exists, one might de
imports that exceed that rate.

	Trade partner (exporter)		
	Full-price policy	No policy	**Partial-price and nonprice policy**
licy	If domestic price is higher, border measure on imports can be instituted to make up difference.	Border measure on imports can be instituted to price those emissions at domestic carbon price level.	**Case 4: Domestic country can price emissions up to foreign standard and any price difference above standard.**
y	N/A	N/A	**N/A**
and licy	**Case 3: Domestic country can apply difference between domestic and foreign price on emissions above domestic standard.**	**Case 1: Domestic country can institute price on imports similar to its domestic scheme.**	**Case 2: Domestic country can institute price on excess emissions depending on relatively stringency.**

ex, with several subcases to highlight (see Figure 2). If a trade
out weaker regulation, the additional stringency in domestic
oplied to imports. *But* stringency has two dimensions—the
he price—and one may be more stringent domestically and the
under the trade partner's policies. In these cases, it would make
charge under the domestic and foreign policies and include a
ference, domestic minus foreign, if this net effect is positive. For
domestic standard is more stringent *and* the domestic price
he domestic price can then be applied on emissions above the
d up to the foreign standard; the difference in prices is applied
e *both* domestic and foreign standards. This (green area) is an
ve charge.



The figure diagrams versions of case 2, when both domestic and foreign jurisdictions hav
differ in terms of the level of standard and the price in the TPS, as indicated by the labele
imported product is above both foreign and domestic standards. The shaded area indica
imported product with the indicated emissions rate.

Now consider a case where the domestic standard is more stringe
is lower (case 2b). The domestic price would be applied to the em
domestic standard and up to the foreign standard (the green area
foreign regulation would be applying an even higher price and we
a credit equal to the red area. Whether the difference—the green
red credit—is positive is unclear. If it were positive, we would sugg
the product. If not, we would not automatically suggest a credit. W
domestic carbon taxes or allowance costs on exports to countries
regulation is essentially the same question as whether to credit im
with more stringent regulation. It is something to consider, but we

ice between the domestic and foreign prices could be applied to
domestic standard (the green area). But we would want to offer
paid in the exporting jurisdiction for emissions above the foreign
he domestic standard (the red area). Any positive difference (the
red area) would be the import charge on this product.

d is more stringent *and* the foreign price is higher (case 4c), no
ssary. The foreign regulation is unambiguously stronger and we
ard the question of export rebates.

h noting about the approach we have just described for case
2d may be more likely in practice. Usually, a more ambitious
will involve a higher marginal cost. Cases 2b and 2c assume
ricter benchmarks have lower marginal costs. Second, if we
-level estimates of embodied carbon (versus firm- or facility-
termine BCAs *and* if the foreign country is using a tradable
d (rather than an ETS with free allocation or some other policy
culations simplify. Foreign emissions, averaged across all
al the foreign standard (which has to be met on average under
y). There are no foreign emissions above the foreign standard,
s to a payment of the difference in standards (in cases 2a and 2b)
ice.

r cases in Table 1 , cases 3 and 4 are similar to case 2. In case 3,
g in a foreign country but a domestic partial-price or nonprice
e already being taxed on all their emissions. Domestic producers
en their emissions are above the domestic standard. However, if
ver than the domestic price, it would seem reasonable to apply
o foreign emissions above the domestic standard *while crediting*
ents below the domestic standard (analogous to case 2c with
equal to "zero"). If the difference is positive, it would be applied
would be the case if the United States, say with a high-price
standard in each sector, were to apply a BCA to EU imports (*and*
e allocation).

estic full-price carbon policy and foreign partial-price or nonprice
em reasonable to apply the domestic price to emissions up to the
issions that are otherwise unpriced. And, similar to case 2b, we
excess price paid for emissions above the standard if the foreign
e domestic. Or if the domestic price is higher, the difference
above the foreign standard would be *added* to the BCA charge
a with a domestic exemption equal to "zero").

Partial-price and nonprice policies have a different structure of co
policies. Therefore, BCAs implemented alongside these policies ne
different things. The underlying notion is really the idea of a stanc
and whether imports miss or meet that standard. Emissions charg
missing the standard, not the overall emissions level. Moreover, ch
the *marginal* cost of the policy—the cost of that last, most expens
this way, the BCA is levying a charge on the carbon content of imp
incentives for the same mitigation action (and mitigation costs); a
outcome occurs, also generate the same additional charge on emi
a similar volume of emissions.

We have noted several challenges with BCAs in the context of par
especially nonprice policies. Even if there is an observed carbon p
nonprice policies means that the marginal cost may not match the
if the nonprice policies create additional emission constraints. Altl
suggested alternative ways to construct marginal cost estimates,
well any would work in practice. For both types of policies, it may
establish a benchmark for exempting foreign emissions before ch
price. Absent a domestic carbon price, the mean observed domes
is a natural starting point. With a domestic carbon price, one need
free allocation may explicitly or implicitly define a benchmark rate
embodied carbon emissions begin.

We have not generally addressed WTO compatibility or myriad otl
These necessarily need to be considered. We believe our effort to
of domestic policy alternatives and how they could be equivalentl
is nevertheless a useful starting point.

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