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POLICY BRIEF

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Linking Emissions Trading Systems with Different Levels of Environmental Ambition

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Highlights

- The environmental ambition of an ETS may be assessed considering three dimensions: emissions coverage, stringency and determinacy.
- Allowance prices are an imperfect metric for the stringency of an ETS. Yet, arguably, they are the best proxy for ETS stringency.
- Beyond the partial equilibrium representation of linking, a range of economic and political factors can diminish a jurisdiction's willingness or ability to link.
- When choosing a linking partner, many factors are weighed up which transcend the compatibility of ETS designs and differences in environmental ambition.
- Linkages between absolute- and relative-cap ETSs are problematic in that overall emissions may increase.
- In the literature, non-cooperative linking most often leads to higher emissions than if the same ETSs operated under autarky.
- There is a shortage of studies simulating the economic impacts of linkages between existing ETSs. More work is also needed to identify the desirable content of future linking agreements.

LIFE DICET

1. Introduction

In the context of the LIFE DICET project[1], the first session of the first Carbon Market Policy Dialogue (CMPD) on "Differences in environmental ambition between ETSs: implications for linking" took place on 10 September 2020. The CMPD sees the participation of the regulators of six major emissions trading systems (ETSs), namely those of the EU, California, China, Québec, New Zealand and Switzerland, and a number of international stakeholders, including policymakers, researchers as well as representatives of industry and civil society. In view of the meeting, a background report (Verde *et al.*, 2020) was produced. This policy brief offers an abridged version of the report and, in addition, it provides a selection of insights from the policy dialogue.

Whenever the linking of two or more ETSs is contemplated, their differences in environmental ambition are likely the first element that is considered. Evaluating whether and how to link ETSs that differ in environmental ambition is not, however, a trivial task. For the jurisdictions involved, linking normally implies a change in the price of the allowances used in their own system. Depending on the magnitude of this change, the resulting price may or may not fall within a range considered acceptable. The same price change implies distributional effects within each jurisdiction and financial transfers across jurisdictions: both things that could pose political difficulties. Nevertheless, linking ETSs that differ in ambition may make perfect sense. Linking systems that have different marginal compliance costs responds to the very same logic of an ETS: minimizing the cost of an emissions reduction target by equalising marginal abatement costs. In fact, cost savings attained through a linkage increase with the difference in marginal compliance costs. Furthermore, the ambition of the systems taken together can be raised if the efficiency gain from the linkage is leveraged to that end. It would, then, be important to clarify from the outset what the goal of a linkage is. *Is it to increase the common environmental ambition of the linkers?* The metaphor of a person's choice of partner, which is recurring in the linking literature, may fit here too as the question is: *what do we want to achieve by being together?*

The policy brief is structured as follows. Section 2 provides the conceptual framework. Section 3 summarises the literature. Section 4 reports some insights from the CMPD. Section 5 discusses and concludes.

2. Conceptual Framework

2.1 Defining Environmental Ambition

While a formal definition of the environmental ambition of an ETS does not exist, by ambition we generally mean the amount of abatement that an ETS promises to deliver. Accordingly, the ambition of an ETS may be assessed considering three dimensions: *emissions coverage*, *stringency* and *determinacy* – as we call it.

By the 'emissions coverage' of an ETS we mean the share of a jurisdiction's total emissions that are regulated. Intuitively, an ETS that covers increasingly large shares of its jurisdiction's emissions indicates, all else being equal, an increasing level of environmental ambition. Similarly, an ETS can be considered more ambitious than other systems that cover smaller shares and are otherwise equivalent in the other relevant dimensions.

The 'stringency' of an ETS refers to its targeted abatement level at a certain point in time or over a time period. It is expressed in terms of deviation from business-as-usual (BAU) emissions, i.e. the emissions expected if the system was not in place. Estimates of BAU emissions and, hence, of stringency,

1. FSR Climate is managing an EU funded project titled LIFE DICET (Deepening International Cooperation for Emissions Trading) which supports European Union and Member States policymakers in deepening international cooperation for the development and possible integration of carbon markets – website: lifedicetproject.eui.eu

come with a margin of error, however. Therefore, alternative metrics that are commonly considered are: a) targeted abatement relative to historical emissions; and b) allowance prices as a proxy for a system's marginal cost of compliance, i.e. the marginal cost of abatement for a given targeted abatement level. Between these two metrics, there are at least three reasons why allowance prices are preferable. First, allowance prices capture the actual economic pressure that an ETS alone exerts on regulated emissions. This is important because many exogenous factors determine regulated emissions, including other climate policies, economic growth and technological shocks. These factors affect allowance demand and, thereby, allowance prices.[2] Second, the stringency of an ETS can vary over time as a result of changes in BAU emissions, and again allowance prices account for these variations. Third, allowance prices allow direct comparisons of stringency between absolute-cap ETSs, a.k.a. cap-and-trade systems, and relative-cap ETSs, which impose a maximum carbon intensity relative to some measure of output (Ellerman and Sue Wing, 2003).

The last consideration leads to the third dimension of environmental ambition: what we call 'determinacy'. In this context, determinacy is the quality of an abatement target to ensure emissions stay below a certain level or, conversely, to accommodate lower or higher emissions depending on the economy's evolution. Some might argue that relative-cap ETSs are by definition less environmentally ambitious than absolute-cap systems, the reason being that the former do not ensure emissions stay within predetermined limits if economic activity turns out to grow more than expected. However, in principle, a relative-cap ETS that is more stringent than an absolute-cap system could be considered more ambitious: it depends on the importance attributed to stringency and to determinacy. Indeed, a relative-cap ETS can be more stringent than an otherwise equivalent absolute-cap system (i.e. it can be expected to induce greater abatement) if economic growth is sufficiently strong or its constraint on emissions intensity is sufficiently tight (Sue Wing *et al.*, 2008; Haites, 2014).

2.2 Environmental Ambition and Linking

Not all the elements that are relevant for assessing the environmental ambition of an ETS, as previously conceptualised, are equally important in relation to linking. Notably, differences in emissions coverage between ETSs are not relevant *per se*. Rather, differences in size matter, that is, differences in the absolute volume of regulated emissions. Size differences are a key determinant of the economic benefits that a jurisdiction can expect to attain by linking its ETS with another. In general, linking to a larger ETS, that is, one larger than other comparable systems, is economically convenient: as a net seller, a jurisdiction will access higher allowance prices and, as a net buyer, it will access lower prices (Doda and Taschini, 2017).

A second point is that differences in stringency between ETSs matter toward linking insofar as they translate into different marginal compliance costs. Differences in marginal compliance costs underlie the main economic rationale for linking, which is to reduce the cost of total abatement, i.e. abatement produced jointly by the systems. Differences in stringency between ETSs normally translate into differences in marginal compliance costs, and hence in allowance prices, but the relationship is not necessarily one-to-one given possible differences in abatement costs between jurisdictions.[3] In principle, it is possible to have equally stringent ETSs that result in

2. In a sense, targeted abatement relative to historical emissions is only a nominal metric, in that it does not account for the many factors other than the ETS itself which determine regulated emissions.

3. Differences in abatement costs between jurisdictions would reflect differences in the availability or cost of abatement technologies. Assuming that abatement costs vary by sector, differences in stringency will not translate one-to-one into differences in marginal compliance costs, and hence allowance prices, also when ETSs differ in sectoral coverage.

different marginal compliance costs; and, conversely, ETSs that differ in stringency but that have similar marginal compliance costs.

3. Literature Review

Part of the literature on ETS linking analyses the economic, environmental, and political implications of differences in environmental ambition between ETSs. It also covers the implications that linking itself, by potentially inducing strategic behaviour, has for the environmental ambition of a linked system.

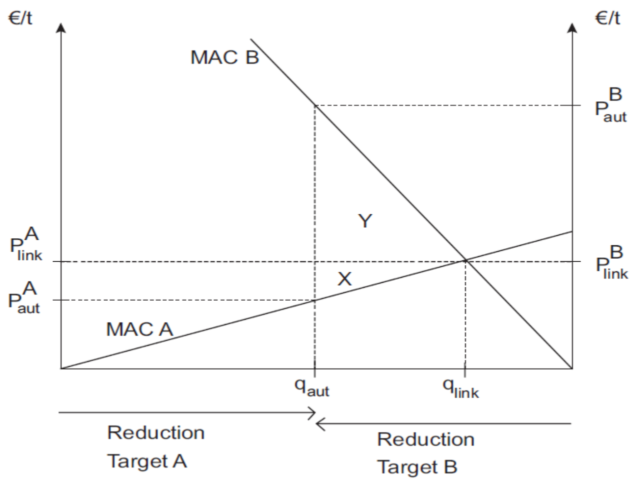
3.1 Economic Implications

The Efficiency Gain of Linking

Differences in marginal compliance costs between ETSs provide the main economic rationale for their linking, namely, reducing the cost of total abatement.[4] As explained, differences in stringency normally translate into differences in marginal compliance costs, but this relationship is not necessarily one-to-one. Besides, differences in marginal compliance costs are deduced from those in allowance prices, though – it is worth recalling – equalisation of marginal compliance costs within an ETS rests on market efficiency assumptions about the allowance market.[5] With these caveats in mind, differences in allowance prices trigger trading between linked ETSs and cost savings are achieved as differences in marginal compliance costs between ETSs narrow. In partial equilibrium analysis, this is the net benefit that always comes with linking, making all jurisdictions better-off.

We refer to Figure 1, which is borrowed from Flachsland *et al.* (2009), to illustrate the immediate mechanisms at play when two ETSs are linked together and how the resulting efficiency gain is distributed between the respective jurisdictions.

Figure 1 - Gains from trade. partial equilibrium analysis.



When ETS A and ETS B are linked together, their pre-link allowance prices, $P^B_{aut} > P^A_{aut}$, converge to an intermediate level, which we call $\bar{P}$ $(P^B_{link} = P^A_{link})$. This $\bar{P}$ level is closer to the pre-link price in the system whose marginal abatement cost (MAC) curve is flatter (ETS A), whether because abatement is less expensive or simply because the system is larger.[6] Indeed, in the graph, just as differences in abatement costs, the relative slope of the MAC curves may reflect the relative size of the ETSs, the flatter curve corresponding to the larger system. Price convergence induces a shift in abatement efforts, from the jurisdiction where abatement is more expensive at the margin (B) to that where abatement is cheaper (A), $q_{aut} \rightarrow q_{link}$. The shift in abatement generates savings in total abatement costs which correspond to the area X+Y. Importantly, this efficiency gain

4. Other economic rationales for linking: eliminating or reducing international competitiveness distortions related to differences in carbon prices, and creating more liquid and hence less volatile carbon markets.

5. In an ETS, equalisation of marginal abatement costs through allowance trade only holds under market efficiency assumptions (Acworth et al., 2017; Hintermann *et al.*, 2016; Flachsland *et al.*, 2009).

6. will be equidistant if the systems are equal in size and also face equal abatement costs.

increases with the initial difference in marginal compliance costs and with the size of the systems (Haites and Mullins, 2001). Moreover, its value partly accrues to B in the form of abatement cost savings (Y area) and partly goes to A in the form of revenue from sold allowances (X area). The distribution of the efficiency gain depends on the relative slope of the MAC curves, with a greater share accruing to the jurisdiction for which the MAC curve is steeper.

Other Economic Effects

In partial equilibrium analysis, linking ETSs with different marginal compliance costs always generates an efficiency gain. This being the starting point, the first element to consider for a more realistic analysis is fixed costs. For example, the process of linking can require costly efforts, including negotiations over the alignment of technical requirements and of design features.[7] If sufficiently large for a jurisdiction, these costs can discourage a bilateral linkage altogether or the participation of a jurisdiction in a multilateral linkage. A natural assumption is that a jurisdiction would only consent to a linkage if it can expect a net benefit from it.

Beyond administrative costs, a range of factors can diminish a jurisdiction's willingness or ability to link. A case in point are the distributional effects, between and within ETSs, that come with any linkage. As these are essentially political hurdles, however, we discuss them separately. Likewise, possible concerns about the reduced environmental ambition that a linkage may cause are discussed in the next section. Other factors are economic in nature, but transcend the partial equilibrium framework considered thus far. For a jurisdiction expecting to export allowances and hence to see allowance prices increase after linking, reduced competitiveness on international goods and services markets may outweigh the revenue from exported allowances (Babiker *et al.*, 2004; Copeland and Taylor, 2005). For a jurisdiction expecting to import allowances after linking, the financial transfer associated with those, as well as reduced fiscal revenues from allowance auctions (if auctioning is used as allocation method), may outweigh the benefit of reduced compliance costs. Also, lower allowance prices may not help achieve sustainable development objectives in the domestic economy (Green *et al.*, 2014; Green, 2017).

Other economic benefits of linking include those promised by the enlargement of the allowance market, notably greater liquidity and reduced price volatility. As Doda and Taschini (2017) show, however, while price volatility can only decrease for two linked ETSs taken together, it might increase for one of them individually – if so, becoming a disadvantage for the corresponding jurisdiction. Price volatility after linking mainly depends on price correlation between ETSs. Moreover, the literature suggests that, for an absolute-cap ETS, linking to a relative-cap system entails greater volatility compared to linking with an absolute-cap system. The reason is that in relative-cap systems allowances are partly distributed *ex-post*, thus causing liquidity spikes at the time of adjustment (Sterk *et al.*, 2006; Blynth and Bosi, 2004).

3.2 Environmental Implications

Linking Absolute- and Relative-cap ETSs

Linkages between absolute- and relative-cap ETSs are somewhat problematic (DEHSt, 2013). The reason is that allowance trading triggers mechanisms whereby output in the jurisdiction with a relative-cap may increase and, as a result, overall emissions increase, too. Fischer (2003) shows that this is a likely outcome, regardless of whether the relative-cap system is net buyer or net seller. In the first case, output increases in the relative-cap system because abatement and thereby production costs fall. In the second, output increases because the output-subsidy

7. On the other hand, linking offers administrative benefits through mutual learning (Burtraw *et al.*, 2013).

effect of the increase in allowance prices outweighs the direct cost increase.[8] The same author, however, identifies a situation where this general result may not apply, namely if output from the two systems are substitutes or complements in the global market. Under such circumstances, cross-price effects may lead to reduced output in the relative-cap system, thus potentially eliminating or even reversing any increase in emissions. Addressing the same question, but using a different model, Marschinski (2008) finds that total emissions fall when the relative-cap ETS is a net seller. The difference with Fischer's (2003) general result is explained by the use of a different production function, namely one with increasing marginal costs, rather than a function with constant marginal costs. Furthermore, linkage leads to increased emissions if, as a consequence of it, allowance prices in a net-seller relative-cap ETS reach a ceiling, so additional allowances are released (Haites, 2014).

On the whole, different outcomes are possible which depend on the specificities of the linkages under consideration. This suggests that numerical simulations with suitable models are needed for evaluating specific linkages between absolute- and relative-cap systems.

Stringency as an Outcome of Linking

As far as total abatement is concerned, linkages between absolute-cap ETSs may seem unproblematic: abatement activity will partly shift across jurisdictions, but total abatement will be unaffected. However, the incentives that linking itself creates for adjusting a system's cap (or the efficiency target in a relative-cap system) may result in total abatement that is greater or smaller than under autarky. This has to do not with different design features of the ETSs, but with whether the respective jurisdictions cooperate to maximise total welfare. A number of studies analyse how the stringency of linked ETSs can be strategically adjusted by governments to their own benefit (Helm, 2003; Rehdanz and Tol, 2005; Carbone *et al.*, 2009; Holtsmark and Sommervoll, 2012; Habla and Winkler, 2018; Lapan and Sidkar, 2019; Holtsmark and Midtømme, 2019). While results differ across studies, depending on model types and assumptions, they usually find that non-cooperative linking leads to higher emissions than if the same ETSs operated under autarky (Holtsmark and Weitzman, 2020). Thus, at a minimum, governments should preemptively agree on abatement targets when linking.[9] On a more positive note, Mehling *et al.* (2018) stress that any economic gain that comes with a linkage also offers an opportunity for cooperatively increasing environmental ambition: *"Linkage is important, in part, because it can reduce the costs of achieving a given emissions-reduction objective. Lower costs, in turn, may contribute politically to embracing more ambitious objectives."*

3.3 Political Implications

Differences in environmental ambition between ETSs that consider linking have important political implications, which are potentially decisive for a linkage to take place and its success. Political challenges arise with two types of distributional effects which accompany the efficiency gain of linking. One of these is revenue transfer between jurisdictions. For a jurisdiction that is net importer of allowances, substantial revenue transfers from the domestic economy into that of the exporting jurisdiction might not be politically acceptable. The magnitude of these flows depend directly on the difference in stringency between the systems, as represented by their pre-link allowance prices (Burtraw *et al.*, 2013).

8. Effectively, relative-cap ETSs simultaneously impose a marginal cost to emissions and offer a subsidy to output (Fischer, 2001).

9. As Green *et al.* (2014) put it, "linking without an agreement on targets would be like a monetary union between countries where each had the right to print money".

At the same time, changes in allowance prices after linking determine winners and losers within each jurisdiction: allowance buyers in the high-price ETS and sellers in the low-price system benefit from the link; conversely, allowance sellers in the high-price ETS and buyers in the low-price system suffer financial losses (Haites and Mullins, 2001). This kind of disparity of impacts may constitute a political barrier to linking.

A second political factor that can weigh decisively against a linkage, especially when the systems involved differ in environmental ambition, is the partial loss of policy control (Jaffe and Stavins, 2008). The limits to policy control regard both regulatory adjustments, which may be needed for a linked system to function properly, and acceptance of co-determined allowance prices; that is, prices that do not exclusively reflect domestic market conditions and may deviate from levels considered preferable from a jurisdiction's own perspective. Importantly, the smaller the size of an ETS relative to the partnering system, the greater, in general, the loss of policy control for its authorities. On the other hand, the jurisdiction with a smaller system normally enjoys a greater portion of the efficiency gain from linking.

The sum of the effects described leads to a paradox whereby the linkages that could yield the greatest benefits in terms of efficiency gains – by virtue of large differences in pre-link allowance prices – may also be politically the most difficult to implement (Ranson and Stavins, 2016; Zetterberg, 2012). Nevertheless, as Burtraw *et al.* (2017) emphasise, a large difference in allowance prices need not be an insurmountable barrier to linking. Various forms of restricted linking (through, e.g., quotas, border taxes, exchange rates, discount rates) represent solutions that, while generally less advantageous in terms of efficiency gains, still provide long-term benefits (Quemin and de Perthuis, 2019).

4. Insights from the Carbon Market Policy Dialogue

On 10 September 2020, the session of the first CMPD meeting on differences in environmental ambition between ETSs and their implications for linking, brought together about 35 international experts. These were policymakers, including the regulators of the six ETSs represented in the CMPD, researchers and representatives of regulated industries and civil society. A selection of the most relevant insights from the discussion is reported below.[10]

- Allowance prices are a key and yet imperfect indicator of the stringency of an ETS, as various factors other than allowance scarcity can affect allowance prices. Keeping in mind this limitation is important especially when comparing stringency between ETSs.
- Differences in ambition between ETSs are not per se the main barrier to linking. For a jurisdiction, the question of whether to link its ETS to another first and foremost raises concerns about policy control, i.e. the possibility to flexibly adjust policy over time.
- Forms of restricted linking can be a useful compromise between a full bilateral linkage, under which actual or perceived policy risks are greatest, and no linkage at all. The gains of trade are smaller under restricted linking than under full linking, but cooperation between ETS authorities can be expected to build mutual trust and bring further benefits over time.
- For a jurisdiction that would be a net seller of allowances in a linkage, the macroeconomic cost of raising the domestic marginal abatement cost may exceed the private benefits from selling additional emission reductions. This is what – counter to the partial equilibrium representation of a linkage – some general equilibrium analyses

10. The CMPD meeting was held under Chatham House rules.

have suggested. The ultimate effect may be negative due to interactions with pre-existing taxes or to changes in the terms of trade. In such cases, international transfers would be needed for a linkage to take place.

- When choosing a linking partner, environmental ambition is a fundamental dimension, but not the only one. Many factors are weighed up which transcend the mere compatibility of ETS designs and differences in environmental ambition. The commonality of broader long-term policy objectives is an important factor in linking decisions. ETS linkages are most likely between jurisdictions that have close political links and share stable long-term commitments to emissions trading.
- Political stability is important in that, especially in bilateral linkages, a jurisdiction needs to trust that the partner's ETS stays on. The failure of a linkage can be costly as well as damaging to the reputation of an ETS. Accordingly, it is desirable that de-linking processes be regulated in advance – i.e. at the time a linkage is agreed – more so than it has generally been the case until now.
- Linkages are not 'one-size-fits-all' and all jurisdictions involved in a linkage to some extent need to adapt to the ETS(s) of the other jurisdiction(s). For a jurisdiction, that might work as long as it has few distinct linking agreements with different parties, but it becomes more difficult as the number of agreements increases.
- In future, ETS linkages may become a common feature of 'climate clubs', with a leader, as for example the EU or China, that draws in other jurisdictions.
- There is a shortage of accurate model-based evidence on ETS linking. Establishing an international platform for modelling integration of carbon markets would help fill this knowledge gap.

5. Discussion and Conclusions

A necessary premise to almost any type of comparison of the six ETSs represented in the CMPD, is that they are in different evolutionary stages. The ETSs of California, Québec, EU and Switzerland are mature systems – they have been operating for several years – and present key design features that are stable and similar to each other. By contrast, both the ETSs of New Zealand and China are in phases of structural (re)definition. As of 2021, New Zealand's ETS will become a cap-and-trade system, like the other four mentioned above (the system has never had its own cap). As to China's national ETS, not only does it have yet to start operating (it is set to start in 2020), but it will be, at least for a few years, a relative-cap system. Our comparison of the six systems is further complicated by the fact that the environmental ambition of an ETS is itself not a univocally defined concept and that different metrics are commonly used to quantify it. We thus suggested that ambition can be thought of and evaluated considering three dimensions of an ETS: emissions coverage, stringency and determinacy. The last two dimensions are particularly important in relation to linking.

Current prospects for new linkages between existing ETSs are considered limited in the near future. However, today – we would argue – the EU ETS and the Swiss ETS may be regarded as a pair of linked ETSs (since 2020) which is comparable to that of California and Québec (linked since 2014). Both these pairs of cap-and-trade systems appear stable, their targets are well-aligned over time[11], and allowance prices are different but not excessively so. While many aspects are taken into account when considering a linkage opportunity, these observed elements are important preconditions. It would thus seem an appropriate moment to start evaluating the possibility of linking the four systems, by simulating economic impacts, by analysing the legal implications, etc.

11. California is committed to achieving climate neutrality by 2045. The European Union aims to achieve the same goal by 2050.

More work is also needed to identify the desirable content of linking agreements. In this regard, part of the linking literature focuses on the strategic behaviour that a linkage can induce. This literature shows the importance of agreeing, when a linkage is negotiated, on the future emission reduction targets of the linked systems. This would serve to exclude the possibility of subsequent unilateral changes in the stringency of an ETS, which could have unwanted repercussions on connected systems. Similarly, it would be desirable to agree on a fluctuation band for allowance prices. The absence of an agreement on this aspect would leave it open to a jurisdiction to manipulate allowance prices to its advantage, notably by making the system more lenient so as to export (import) more (fewer) allowances. Without altering its emission reduction targets, a jurisdiction could do so by modifying the policy mix that affects the emissions regulated by its ETS. Harmonizing the mechanisms for controlling allowance prices and agreeing on their fluctuation limits is, therefore, not a separate issue from that of agreeing future mitigation targets.

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The Robert Schuman Centre for Advanced Studies, created in 1992 and directed by Professor Brigid Laffan, aims to develop inter-disciplinary and comparative research on the major issues facing the process of European integration, European societies and Europe's place in 21st century global politics. The Centre is home to a large post-doctoral programme and hosts major research programmes, projects and data sets, in addition to a range of working groups and ad hoc initiatives. The research agenda is organised around a set of core themes and is continuously evolving, reflecting the changing agenda of European integration, the expanding membership of the European Union, developments in Europe's neighbourhood and the wider world.

The Florence School of Regulation

The Florence School of Regulation (FSR) was founded in 2004 as a partnership between the Council of the European Energy Regulators (CEER) and the European University Institute (EUI), and it works closely with the European Commission. The Florence School of Regulation, dealing with the main network industries, has developed a strong core of general regulatory topics and concepts as well as inter-sectoral discussion of regulatory practices and policies.

Complete information on our activities can be found online at: fsr.eui.eu

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