

Gradual Introduction of Coercive Instruments in Climate Policy

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Résumé

Ce papier traite de l'accroissement de l'acceptabilité, i.e. discute de la mise en œuvre d'un mécanisme pour la préparation graduelle du citoyen et de l'économie à la mise en place d'une taxe sur le carbone. Il fait référence aux expériences effectuées en Suisse, où des approches volontaires ont été combinées avec une taxe sur le CO₂. De manière plus générale, ce papier discute de la dynamique de la politique climatique dans une démocratie, dans laquelle la mise en place des lois est toujours participative. Il analyse la genèse de la loi suisse sur le CO₂, en particulier l'historique d'une première tentative avortée, afin de montrer la mise en œuvre d'une approche stratégique particulière permettant de répandre les approches volontaires. L'approche semblait être couronnée de succès, créant le support nécessaire pour introduire la taxe sur le carbone. Cependant, une proposition de dernière minute concernant une taxe privée sur le prix des combustibles a remis tout en question et paraît miner toute l'architecture de la loi sur le CO₂. Nous interprétons ce qui n'a pas marché et en tirons des leçons générale pour la politique climatique.

Mots-clés

Politique climatique, changements climatique, instruments économiques, approches volontaires, taxe sur le carbone, taxe sur le CO₂, acceptabilité.

Summary

This paper is about acceptance building, i.e. devising a mechanism for the gradual preparation of the citizenship and the economy in order to implement a carbon tax. It draws from the experiences made in Switzerland, where voluntary approaches were combined with a CO₂ tax. More generally, this paper is about the dynamics of climate policy in a democracy, where law making is always participatory. It analyses the genesis of the Swiss CO₂ Law, in particular the history of an earlier aborted proposal, to show the setting up of a peculiar strategic approach that spawned an array of voluntary approaches. The approach seemed about to succeed in creating sufficient support for the carbon tax. However, a last minute proposal of a private levy on fuel prices upset everything and seems about to fully undermine the CO₂ Law. We interpret what went wrong and attempt to draw general lessons for climate policy.

Keywords

Climate policy, climate change, economic instruments, voluntary approaches, carbon tax, CO₂ tax, acceptability

INTRODUCTION

Although the literature has demonstrated at length that carbon taxes are an effective and efficient instrument for meeting an emissions reduction target, their implementation proves extremely difficult. In addition, those countries that managed to introduce a carbon tax set it at ineffective low levels and/or exempted large parts of the economy and of the emitters. However, when exemptions are granted in exchange of equivalent abatement commitments, effectiveness can still be obtained. Such combinations of a carbon tax with voluntary approaches (VAs) can achieve acceptance. Acceptance is the key problem of carbon taxes. This paper is about acceptance building, i.e. devising a mechanism for the gradual preparation of the citizenship and the economy in order to implement a carbon tax. It draws from the experiences made in Switzerland, where voluntary approaches were combined with a CO₂ tax.

Several aspects make the Swiss approach interesting. First, Switzerland is characterized by a high level of direct democracy. For instance, the electorate voted several times on fuel and energy taxes. A first draft of the CO₂ Law, which provided for an unconditional tax, was completely redrafted after a wide consultation, and the final draft was subject to voluntary referendum, but this popular right was not used, indicating a potentially relatively large acceptance of the CO₂ Law.

Second, the strategic setting of the Swiss CO₂ Law is unusual. It provides for a conditional CO₂ tax, which must be approved by the Federal Council (the national government) and its rate by Parliament. The Federal Council was to implement the tax at the earliest in 2004, if it judged that existing policies and declarations of self-regulation (both are described below) were insufficient to achieve the emissions reduction objective fixed in the Law. When the tax is implemented, large firms and associations of energy users may be exempted, provided they commit in negotiated agreements to lower their CO₂ emissions. That strategic approach is intermediate between that of countries such as France and Germany, which had no concrete projects for a carbon tax, but where energy-intensive sectors pledged, without commitment, to reduce their CO₂ emissions, with a view to averting a carbon tax (Krarup and Ramesohl, 2002),¹ and countries such as Denmark and the UK, which implemented a carbon tax and then proposed energy-intensive firms a lower rate in exchange of their commitment to reduce their CO₂ emissions (Bjørner, 2004, de Muizon and Glachant, 2004).

Exemptions from existing taxes and regulation are one frequent motive for voluntary abatement (see Thalmann and Baranzini, 2004). The threat of such taxes or regulation, which can presumably be fended off by voluntary

abatement, is another. In the case of Switzerland we have both. The threat of the tax was more explicit than usual, as the CO₂ Law provided already for a CO₂ tax, but its implementation depended on forecasts about whether collective abatement efforts would be sufficient to meet the emissions target. Such a scheme raises a tremendous free-rider problem at the national scale. So a second provision in CO₂ Law created a direct incentive: qualifying energy consumers would be fully exempted from the tax if they firmly committed to reducing their CO₂ emissions. Firms and coalitions of energy-users that promised emissions reductions prior to the implementation of the CO₂ tax were in the best position to obtain an exemption from it should the CO₂ tax be implemented.

How did the economy respond to those mixed incentives? Which sectors managed to organize and set up the means to achieve the target? Did the many decentralized VAs suffice to avert the tax? Was the tax finally implemented as provided by the Law? Those questions are particularly interesting in the case of CO₂, as there are so many different emission sources. More generally, this paper is about the dynamics of climate policy in a democracy, where law making is always participatory.² First, it provides some background information on Swiss energy consumption and CO₂ emissions and compares them to the Kyoto target. Then, it analyses the genesis of the 1999 CO₂ Law, in particular the history of an earlier aborted proposal, which will help understand its peculiar strategic approach. Considering the VAs that were adopted under the Energy and the CO₂ Laws, the approach seemed about to succeed. However, a last minute proposal of a private tax upset everything and seems about to fully undermine the CO₂ Law. We interpret what went wrong and attempt to draw general lessons for climate policy.

BACKGROUND MATERIAL

Switzerland ratified the United Nation's Framework Convention on Climate Change (UNFCCC) in 1993 and the Kyoto Protocol in June 2003. In the Protocol, Switzerland's commitment amounts to 8 per cent reduction in its net emissions of six greenhouse gases (GHG) over the period 2008–12, compared to 1990 emissions. This is the same target as for the European Union.

This section shows that Switzerland is already quite efficient in its use of fossil energy and that it will be difficult and thus relatively costly to further lower CO₂ emissions. Those emissions are stabilized since the 1990s, but it is doubtful that they will decline to the targets set in the Kyoto Protocol and CO₂ Law. This section also shows the main drivers of that evolution.³

The CO₂ Emissions Level

In 2000, total GHG emissions amounted to 52.7 million tonnes of CO₂ equivalents (without international bunkers). If CO₂ removal by sinks is considered according to the UNFCCC reporting methodology, net GHG emissions correspond to 50.9 million tonnes of CO₂ equivalents. CO₂ represents the largest proportion of gross GHG emissions (about 83 per cent), followed by methane (8.5 per cent). The transport sector (30 per cent), the residential (22 per cent) and industrial (18 per cent) sectors are the major emitters. About 80 per cent of total GHG emissions are energy-related. Given the Swiss energy consumption profile, that means that the greatest part of GHG emissions stems from the use of fossil fuels. That explains why the CO₂ Law only addresses CO₂ emissions linked to the energetic use of fossil fuels.

Switzerland belongs to the countries with the best environmental indicators in the OECD. It contributed 0.17 per cent of world CO₂ emissions in 2000. Its 6 tonnes of CO₂ emissions per inhabitant per year is only half the OECD average (12.2 tonnes), but above the world average of 4 tonnes. Relative to GDP, Switzerland's performance is even better, with 0.26 tonnes CO₂/1000\$ compared to an OECD average of 0.74.

Several factors explain that good performance. First, Switzerland imports a very large proportion of intermediates and final goods with high energy content. The emissions associated with the production of those goods are not counted as Switzerland's contribution to the accumulation of GHGs. They have been estimated at 60 to 70 per cent of domestic emissions.⁴ A second and related factor is the near absence of heavy industries and the high share of the services sector in GDP (67 per cent in 1999). A third factor is the near absence of coal- or oil-fired power plants for electricity generation. The first nuclear power plant was hooked to the grid in 1969. Thirty years later, nuclear power plants produce nearly 35 per cent of electric energy. Sixty per cent are produced by hydroelectric power plants. The production of thermal power stations has been insignificant throughout the twentieth century. Of course, the high shares of hydropower and nuclear in electricity generation help keep down CO₂ emissions. However, electricity represents only 22 per cent of total final energy consumption of 855.3 PJ in 2000.⁵ The bulk share is that of oil products and they are entirely imported.

The drawback of this good performance is that it will be quite costly to further reduce the CO₂ intensity of the Swiss economy. Even the 8 per cent target set in the Kyoto Protocol would be very demanding if economic growth were not so sluggish. Indeed, it is generally recognized that marginal abatement cost for Switzerland is among the highest in OECD countries (for example, see Kram and Hill, 1995; Bahn, Fragnière and Kypreos, 1998).⁶ On

the other hand, Switzerland has additional incentives for reducing its use of fossil energy, namely reducing its imports and its dependency on world oil supply.

The Evolution of Energy Consumption and CO₂ Emissions

Swiss energy consumption still increased more rapidly than population in the 1990s. In 2000, an individual used 2 per cent more energy than in 1990. Economic growth was the most important driver of the evolution of energy consumption in the 1990s, in spite of its sluggishness (GDP grew by less than 0.9 per cent per year on average). Policies in favour of energy saving and improvements in energy efficiency were moderating factors. Gasoline prices were relatively stable in real terms, while heating fuel prices declined by some 30 per cent.

In spite of the growth of energy consumption, CO₂ emissions were stabilized and actually declined relative to population and GDP. Indeed, the share of fossil fuels in total energy consumption decreased from 73.6 per cent in 1990 to 71.5 per cent in 1999.

Transportation accounts for about 32 per cent of energy consumption and 35 per cent of CO₂ emissions (2000). Road traffic emits some 98 per cent of that CO₂, nearly all trains being powered by electricity. The share of freight transport in the road's contribution to CO₂ emissions is 23 per cent. Over the last 50 years, transportation doubled its energy consumption, in close correlation with the exponential growth of the number of cars. In comparison, the industry sector diminished its share of energy consumption from 31 per cent to 18 per cent during the same period. The result is a growing contribution of transportation to total CO₂ emissions. Thus, total emissions of CO₂ grew by a factor of 5 between 1940 and 1970, but emissions from transportation grew by a factor of 10 over the same period. After 1970, emissions from all sources and from transports grew more slowly, with a steeper slope for transports. Currently, emissions reductions from heating and process fuels are offset by increases in emissions from motor fuels.

Swiss Climate Policy: A Mixed Bag

Switzerland does not address climate change with a unique policy, but rather with a combination of measures and policies in various areas. The main spearheads of its strategy are the Federal Law on the reduction of CO₂ emissions ('CO₂ Law') and the Federal Energy Law. The 1999 CO₂ Law sets as an overall target that CO₂ emissions over the period 2008–12 have to be 10 per cent below the 1990 level, with differentiated targets for heating and process fuels on the one hand (–15 per cent) and motor fuels on the other

hand (–8 per cent).⁷ The law provides for a ‘supplementary’ CO₂ tax to be implemented, if necessary, at the earliest in 2004 and the revenues of which are to be fully redistributed to the population and economic sectors.

The 1998 ‘Energy Law’ calls for extensive collaboration with the private sector, mainly within the framework of a public voluntary programme called ‘SwissEnergy’, which replaces the ‘Energy 2000’ (E2000) programme that ran from 1990 to 2000. Private energy agencies have been created in order to coordinate, evaluate and monitor voluntary initiatives. The programme mainly focuses on energy efficiency, in particular of electrical appliances, vehicles and buildings, but also favours the production and use of renewable energy.

Switzerland did not have a policy targeting explicitly climate change before 1990, when it launched the E2000 programme in the context of the Federal Energy Law. However, it might still have been the first country in the world to implement a programme that tackled explicitly CO₂ emissions, in fact the same year that the United Nations officially initiated negotiations on a framework convention on climate change. E2000 relies essentially on voluntary approaches. It will be discussed in detail below.

Various existing policies and measures have a direct or indirect impact on GHG emissions (for a survey, see, for example, Baranzini and Ruetten, 1998). Those policies are implemented in the fields of energy, agriculture, forestry, transportation and environmental protection.⁸ They use economic instruments, regulation, public investments, and voluntary approaches. In general, each policy combines the use of different measures, for instance economic instruments (subsidies, taxes, etc.) are often complementary to regulatory measures (e.g. obligations, permits, interdictions and conditional applications) and to voluntary approaches undertaken by the private sector in order to achieve the objectives set by the public authority.

Economic instruments encompass subsidies for energy conservation, particularly in buildings, the development of renewable energy sources, and the reduction of intensive agriculture. Taxes on gasoline, which have a revenue purpose, increase the price at the pump by about 50–60 per cent, and a new lorry tax is levied since 2001 on heavy goods vehicles based on the product of distance travelled on Swiss roads and maximum permitted total weight. Regulation is widespread in energy production and consumption, both in the form of technical prescriptions and emission limits. Forestry law limits the reduction of forest size since 1876. Finally, the promotion of hydro- and nuclear power and of public transportation and the railways also contribute to lower the CO₂ intensity of the Swiss economy.

Although the Federal Administration expects that those measures will contribute to meet the targets for GHG emissions, it understands that they may not be sufficient. Furthermore, it is not always possible to extend those

policies to reinforce their impact on GHG emissions. For instance, the legal basis for the limit values of the Clean Air Act is public health, so concentration levels must increase, before limit values for emissions can be lowered. Moreover, the effectiveness and efficiency of those policies depend largely on their coherence. Thus, for instance, the Clean Water Act strongly restricts landfills, so that nearly all waste must be incinerated, which increases air pollution and GHG emissions, but also contributes to reduce fossil fuel use, because they combine heat and power production.

THE MAKING OF THE CO₂ LAW

This section analyses two successive projects for a Law on reducing CO₂ emissions: the draft proposal of 1994 and a new proposal of 1997, which became law in 1999 (CO₂ Law). Since the 1999 CO₂ Law arose from the failed project of 1994, it is instructive to compare the two projects and to see what was added and removed in the political process to ensure the acceptance of the CO₂ Law by nearly all sectors of the economy and political parties.

The 1994 Project

In the wake of the Rio Earth summit, on March 23, 1994, the Federal Council put up for consultation a project for a Law on reducing CO₂ emissions, the core of which was a CO₂ tax to be raised as early as 1996 (DFI, 1994). The tax base was the same as for the 1997 project. It covered all imported fossil fuels used as energy source. Fuels used by oil refineries and international air traffic were exempted. So was oil used in the chemical, textile or plastic industries and the carbon used in making imported products, even though carbon dioxide would be emitted during incineration. As a result, the CO₂ tax would have covered 90 per cent of all CO₂ emissions and 75 per cent of all GHG emissions as defined by the Kyoto Protocol (2000 data).

The tax was to be levied on fossil fuels on the basis of their carbon content, at the rate of CHF 12 per tonne of CO₂ in 1996, rising to CHF 24 in 1998 and finally peaking at CHF 36 in 2000.⁹ On a carbon basis, the rates were roughly CHF 44, CHF 89 and CHF 123 per tonne of carbon. Those rates were to be adjusted for inflation. The projected Law provided for relief from tax for very energy-intensive producers. It reserved one-third of tax revenues for subsidies to environmentally friendly measures. The remaining two-thirds were to be recycled as follows: three-quarters for households, as a constant amount per capita handed out in the form of reduced health insurance premiums, and one-quarter given to businesses in the form of lowered social security contributions. Clearly, the purpose was to redistribute

the tax revenues with minimum administrative cost, without consideration to optimal taxation and double dividend arguments.

The Federal Council had to abandon the project under strong opposition from the major political parties and economic sectors. It did not even submit the project to Parliament. The critiques focused on the macroeconomic consequences of the tax, the impact on different income groups and the mode of revenue recycling.

The 1997 Project and 1999 CO₂ Law

Since Switzerland signed the Kyoto Protocol in 1997, it needed a set of instruments to meet its commitment. So the Federal Council prepared a new project for a CO₂ Law, despite the defeat of its 1994 project, but it drew the lessons from that failure. It put voluntary approaches forward, on the model of the well-appreciated E2000 programme, keeping the CO₂ tax in reserve for the case that voluntary efforts proved insufficient. It gave up all ideas of using the revenues of the potential tax instead of returning them fully to the citizens and firms. There was a heated debate about the tax rate and about who was going to decide about it, but the new project was approved by Parliament in October 1999 and came into force in May 2000, without any major opposition.

The new CO₂ Law aims to reduce by 10 per cent average CO₂ emissions arising from the utilization of fossil fuels as energy over 2008–12, compared to 1990 emissions. The aggregate target is a 10 per cent reduction and not the 8 per cent reduction commitment in the Kyoto Protocol, because it covers only about 75 per cent of GHG emissions. The Law explicitly provides for the possibility to take into account emissions reductions operated outside Switzerland, through the international economic mechanisms (international emissions trading, joint implementation and the clean development mechanism) of the Kyoto Protocol.

Under the CO₂ Law, the Federal Council must estimate every year whether existing measures and instruments appear sufficient to meet the target. If not, it introduces a CO₂ tax, at the earliest in 2004. Before doing so, it takes into account reductions already achieved, the economic situation, international competitiveness and current fuel prices in neighbouring countries. It may choose different CO₂ tax rates for heating and process fuels on the one hand and for motor fuels on the other hand. It may even opt to introduce the tax only for one and not the other source of CO₂. When the Federal Council decides to implement the CO₂ tax, its rates must be approved by Parliament.

If a CO₂ tax is implemented, an Ordinance will describe the details of its application. However, the law already places a ceiling at CHF 210 per tonne

of CO₂, which corresponds to about CHF 770 per tonne of carbon. This is about six times higher than the maximal rate envisioned by the 1994 project. Contrary to the 1994 project, the 1999 Law does not guarantee a blanket exemption for energy-intensive firms, but it requires that they (alone or in groups if they are small businesses) commit to reductions in their emissions in a negotiated agreement. If they do, they are fully exempted from the tax. That option is also offered to large firms and alliances of fuel consumers (see below). Thus, voluntary efforts are invited at two stages: first for voiding the necessity of the tax and then, if the tax is implemented, to obtain exemptions.

The generated tax revenues will be completely redistributed without financing any additional government spending, contrary to the 1994 project. The revenues should be returned to households and businesses in aggregate shares corresponding to the contribution of each sector. The channels for revenue recycling are the same as in the 1994 project, that is, lump sum redistribution for households and in proportion of social security contributions for firms.

Assessment

The 1997 project sailed through consultation and Parliament without much opposition. The economy had participated in the preparation of the law, including the differentiated targets. The debate focussed on how much time should be granted for VAs before deciding on the CO₂ tax and who would take the decision to implement the tax, as well as its rate – the Federal Council or Parliament. It was understood that Parliament would be more sensitive to the interests of the economy, which on the other hand would reduce the credibility of the tax ‘threat’. Here are some possible explanations for the relatively easy acceptance of the 1997 project:

- Nearly everyone agrees that CO₂ emissions pose a threat to our planet and that global warming might have severe consequences, even for the Swiss economy.
- The CO₂ tax is only supplementary and even though the Federal Council will decide to implement it, many hoped that Parliament would not approve a high tax rate, even if it became necessary for the target to be met.
- The law allows for different tax rates on heating and process fuels and on motor fuels. Thus, it breaks the solidarity between all CO₂ emitters. Industry, which can much more easily get organized and commit to emissions reductions than car drivers, can obtain a reward for its efforts without them being undone by increased fuel consumption on the roads.

Motor fuel users now face the threat of a tax potentially six times higher than in the 1994 project.

- The tax can be averted through sufficient non-binding promises of efforts to be made until 2010. Some may have expected that light promises would do. As we shall see in the next section, the responsible authority later drafted very detailed and complicated rules for acceptable declarations of self-regulation.

When drafting the CO₂ Law, almost all actors were convinced that a CO₂ tax is the only instrument capable to guarantee that the Kyoto commitment can be met. The voluntary approaches were introduced in a strategic game between the industry, which wanted them to buy time and get its own lower tax rate (including no tax at all), and the Government and environmentally oriented politicians, who accepted them to get the Law approved at all.

SETTING UP VOLUNTARY APPROACHES

Baranzini, Thalmann and Gonseth (2004) present and assess in detail the VAs used to reduce fuel-related CO₂ emissions. Here, we report only the main features of the declarations of self-regulation. Those declarations could avert the CO₂ tax if the promised efforts convinced the Federal Council that the tax was not needed for meeting the overall emissions target. Should the tax be introduced, many of the declarations of self-regulation would be converted into more formal negotiated agreements, which would exempt their signatories from the CO₂ tax in exchange for keeping their commitments.¹⁰

Declarations of Self-Regulation

Declarations of self-regulation are written declarations on energy conservation, which may also contain a target for reducing CO₂ emissions (SAEFL, 2001). Thus, their legal status rests on the energy law more than on the CO₂ Law, and they are handled under the umbrella of SwissEnergy. However, the Federal Council will take them into consideration when it decides whether the CO₂ tax is needed and they are also promoted in that context.

Any individual firm or association of firms of the same sector or region can sign a declaration of self-regulation. In doing so, it announces a target value for its energy efficiency with reference values for 1990, 2000 and 2010, an improvement path and intermediate targets with assessments in 2003 and 2007. The Confederation then requests a third-party audit of the declaration before registering it. Each year, the author of the declaration of self-regulation must deliver to the federal government a report with data on its energy consumption for each source of energy, on energy efficiency and on CO₂ emissions. Independent experts audit the reports.

About 1300 firms engaged in the process of preparing declarations of self-regulation, generally with the help of Energy Agencies, private organisations set up with federal support. Large firms formed groups of 8 to 15 members committing jointly, while smaller firms formed groups of 30 and more members in the same industry or with similar production processes. The reporting requirements vary with the size of the firms and groups, but one thing is common to all: setting up those groups and their commitments proved unexpectedly costly.

Since the CO₂ Law came into force in 2000, three declarations of self-regulation were signed directly with large associations of energy users and six with groups organized by the Energy Agency for the Economy. The first

declaration of self-regulation was signed in February 2002 by the member of the Federal Council Moritz Leuenberger and the chairman of the Association of Car Importers, which groups nearly all licensed importers (Switzerland has no car-making industry). The importers announced that they would take measures to lower the average consumption of new cars from 8.4 litres/100 km in 2000 to 6.4 l/100 km in 2008, with a decrease by 0.25 l/100 km every year. This declaration was painless for two reasons. First, importers expect to meet most of the target by promoting diesel cars,¹¹ which consume 30 per cent less fuel *in litres* than a gasoline car of the same power (the emissions of CO₂ decrease only by about 15 per cent). Second, there was already an ordinance implemented in 1996 that set fuel efficiency targets for new cars. If those targets were not met by 2001, the Federal Council was to regulate fuel efficiency. In 2001 the target was missed by half, but instead of regulation, the Federal Council accepted a further declaration of self-regulation by the car importers. All the intermediate targets set in that new declaration have been missed since 2003, without any consequence.

In February 2003, the Federal Council signed the second declaration of self-regulation, with the president of Cemsuisse, the organization of the cement industry. The target is a reduction of CO₂ emissions from fuels by 44.2 per cent in 2010 compared to 1990. The main measure to achieve this target is to replace more coal and oil as a source of fuel by waste products: used oil, dry sewage sludge, animal flour, used solvents and plastic wastes. The cement makers already get 40 per cent of their heat from those alternative fuels. Burning them of course also emits CO₂, but it is not counted under the CO₂ Law and they would be incinerated anyway. In addition, the industry announced it would reduce CO₂ emissions freed when calcium carbonate is transformed into lime by 30.3 per cent until 2010 compared to 1990, even though those emissions are not counted under the CO₂ Law.

The cement industry's commitment must be assessed in the context of reduction in CO₂ emissions already obtained: more than 35 per cent of its emissions from fossil fuels between 1990 and 2000. Of course, marginal abatement costs are rising. The cement industry is a good candidate for CO₂ reductions, not so much because it emits a lot of CO₂ (3 per cent of Swiss emissions in 1990), but because of relatively low abatement costs. Nevertheless, most of the CO₂ emissions in the sector of industrial processes stem from the cement industry (SAEFL, 2001). That industry, which is concentrated like few others, is a long-time partner of public authorities in helping them get rid of growing mounts of waste. It reduces the pressure for finding alternative solutions to reduce the production of waste. Thus, the industry's commitment is also a good deal for the public as a producer of garbage.

In 2004, only four energy-model groups with 42 firms and two benchmark-model groups with 79 firms had their declarations of self-regulation audited and approved by the federal administration (see EnAEc, 2003). The total CO₂ emissions of those groups is 265 000 tonnes/year. Those declarations deal exclusively with heating and process fuels and most of them can be transformed into negotiated agreements if the CO₂ tax is implemented. The EnAEc (2003) states that the targets are markedly better than the 15 per cent reduction in CO₂ emissions target for the sector, but also that presently the sample is too small to allow for generalization. When all prepared declarations of self-regulation are approved, about one-third of all CO₂ emissions related to heating and process fuels attributed to industry, services and trade will be included under reduction targets: That is one sixth of all CO₂ emissions related to heating and process fuels, for which the target is a 15 per cent reduction relative to 1990. The reduction target for participating firms would thus have to be 90 per cent for the overall target for heating and process fuels to be met, which is obviously not the case.

Assessment

Participation in VAs is often explained by the threat of a more demanding policy that would be implemented if voluntary efforts were insufficient (Langpap and Wu, 2004). In this respect, Switzerland is an interesting case, since the CO₂ Law explicitly spells out such a threat with a CO₂ tax that could be seen as punishing insufficient collective efforts. Emitters who make a declaration of self-regulation bear set-up and some abatement costs before the tax is introduced. If the tax is introduced, they have to pay it in spite of their efforts (but they stand a good chance of being exempted). Emitters who do not make a declaration of self-regulation only bear costs in the case the tax is decided. Making a declaration reduces the probability that the tax is decided, but for most emitters only marginally. So we have a classical free-rider problem and we should not see any declarations of self-regulation.

Nevertheless, declarations were signed. Clearly, there exist other motives for saving energy and participating in VAs, which are listed in Thalmann and Baranzini (2004). In addition, the economy tried to mitigate free-riding through the co-ordination activities of the energy agencies. Their assistance lowered the set-up costs of the declarations and abatement costs. In our opinion, three further factors were decisive for encouraging emitters to make declarations of self-regulation: (1) the targets were set with a view to economic feasibility; (2) since there are virtually no penalties for non-compliance, declarations of self-regulation may be cheap signals to the Federal Council that a CO₂ tax will not be necessary to achieve the target;¹²

and (3) signatories of declarations of self-regulation are in the best position to obtain negotiated agreements that would exempt them from the tax.

Preparing the declarations of self-regulation has generated an impressive mobilisation of knowledge in the area of energy conservation and certainly contributed to foster awareness and a sense of responsibility in the industry. For that mobilisation to be sustained and commitments to be kept, it is important that the authorities keep their own commitments set in the CO₂ Law. Many participants in declarations of self-regulation expect the introduction of the CO₂ tax and their exemption from it as a reward. There is nothing automatic in the transformation of declarations of self-regulation into negotiated agreements. Nevertheless, some emitters who signed declarations of self-regulation, presumably to avert the tax, are now demanding the tax in order to penalize other emitters who did not promise any effort or even to raise the barriers against market entry (see Brau and Carraro, 2004).

Thus, leaving time for voluntary approaches had the unexpected virtue of creating a constituency in favour of the tax akin to that created in the USA by granting early emission reducers tradable permits that become valuable only after caps are imposed on emissions (Lyon and Maxwell, 2004). The stated goal of the delay, which was to give voluntary approaches a chance, was doomed from the start. There was no way that an undefined set of firms committing to reduce their emissions by 15 per cent could lead to an overall reduction of 15 per cent.

Delaying the introduction of the tax now requires higher rates. Furthermore, setting up an array of tailor-made declarations of self-regulation proved extremely expensive in transaction costs. No one seemed to worry about the possible economic consequences of putting competitors around a table to discuss production processes and projections and propose joint reduction targets (for a discussion, see Brau and Carraro, 2004). Of course, Switzerland has a long tradition of leniency towards cartels.

RENEGING THE CO₂ LAW COMMITMENT

Forecasts of CO₂ Emissions: Will the Targets Be Met?

Using a computable general equilibrium model (GEM-E3) applied to Switzerland, Bahn (2001) and Bahn and Frei (2000) simulated a business-as-usual (BAU) scenario for CO₂ emissions. They considered two scenarios, low and high growth, the main difference being the assumptions on technical progress and on the increase in fossil fuel prices. Those BAU scenarios did not account for the possible impacts of the new CO₂ and Energy laws on CO₂ emissions. In the high growth scenario, CO₂ emissions will grow by 2 per

cent by 2010 (up to 46 million tonnes), with respect to 1990 emissions level. Therefore, to attain the CO₂ Law target, Switzerland will have to reduce 5.5 millions tonnes of CO₂, corresponding to a reduction of about 12 per cent of emissions, compared to the BAU scenario. In the low growth scenario, emissions will stabilize at 45.1 million tonnes by 2010, which thus requires a reduction of about 10 per cent, with respect to the BAU scenario. Bahn and Frei (2000) estimated that a CO₂ tax with a rate of CHF 45 per tonne of CO₂ in 2005 and CHF 103 in 2010 will be necessary in the high growth case, in order to attain the target set in the CO₂ Law.¹³

The Federal Council asked the research centre Prognos (2002) to make projections on future GHG emissions based on different energy scenarios, which all included the effects of the new CO₂ and Energy laws, without the CO₂ tax. Those scenarios took into account changes in the baseline and the effects of implemented and planned policy measures (in particular existing declarations of self-regulation, see above). The baseline was built on assumptions about economic and demographic growth, the development of alternative energy sources like nuclear power, energy prices, and so forth. The reference scenario assumed relatively low energy price-elasticities (-0.1 in the short run, -0.2 in the long run). Two other scenarios used more and less favourable conditions, not only relative to the key economic and demographic variables, but also relative to traffic growth and the extent to which energy saving related standards are applied.

The baseline scenario yielded a better result compared to Bahn (2001). Indeed, for the average of 2008–12, CO₂ emissions were predicted to decrease by 4.4 per cent (-1.8 million tons) compared to their 1990 level, which is, however, short of the 10 per cent target set in the CO₂ Law. Heating fuels emissions were forecast to decrease nearly to the extent defined in the Law (11.6 per cent vs. 15 per cent), but motor fuels emissions were forecast to rise by 7.6 per cent while the CO₂ Law calls for an 8 per cent reduction. Even in the most favourable scenario, in which the target for heating fuels emissions is achieved, the target for motor fuels emissions is still out of reach.

A further analysis was conducted by the Centre for Energy Policy and Economics at ETHZ (Jochem and Jakob, 2004). It concluded that CO₂ emissions in Switzerland would drop by 1.3 per cent below the level of 1990 by 2010 instead of the 10 per cent envisaged by the Law. In order to reach that target, the authors simulated a tax on heating and process fuels of 50 CHF/tonne CO₂ and on motor fuels of 100 CHF/tonne CO₂ implemented in 2005. That tax would raise the price of heating oil by 25 per cent, of natural gas by 20 per cent and of gasoline by 15 per cent. The resulting prices would not be higher than in neighbouring countries. They would lead to a business slowdown between 0.3 and 0.5 per cent.

In view of all those forecasts, the Federal Council was bound by the CO₂ Law to propose to Parliament the implementation of a CO₂ tax in 2004. It proposed a partial tax in 2005, which is still hanging in the parliamentary maze today (October 2006). What happened?

The 'Climate Penny' Popped Out of the Hat

In 2001, Mrs Ann Arquit Niederberger at that time Deputy Head of Climate Change Affairs at the Swiss Agency for Environment came up with a proposal for a private fund into which oil importers would pour a small amount for every litre of gasoline or diesel sold in the country. The fund would use that money to buy cheap CO₂ emissions certificates on world markets. That idea was taken up and promoted by the Swiss Oil Association. In 2003, Mrs Arquit Niederberger proposed in the main business daily the creation of a private 'climate penny fund', fed with 0.01 to 0.02 CHF per litre gasoline and diesel sold in the country. She estimated that the yearly revenues would allow to buy CO₂ emissions certificates and subsidize some conservation measures domestically in order to compensate for the excess of CO₂ emissions from the transport sector relative to the CO₂ Law target (Arquit Niederberger, 2005). In 2004, the Swiss Oil Association proposed that mechanism as a last-minute declaration of self-regulation, with the support of automobile associations.

The 'climate penny' proposal can hardly be defended as a declaration of self-regulation under the letter and spirit of the CO₂ Law as it does not contain a commitment to reduce CO₂ emissions by its initiators. Furthermore, most of the reduction would be obtained abroad, while the spirit of the Kyoto Protocol requires that most of the GHG emissions should be abated domestically. So the Federal Council did not accept that proposal as it accepted the other declarations of self-regulation. However, it organised instead a formal consultation over four alternative packages.

The first package had distinct CO₂ taxes estimated to be sufficient to meet the CO₂ Law targets: one on heating and process fuel and the other on motor fuel. This was clearly the package envisioned when the CO₂ Law was drafted and approved. The second package had a uniform and lower tax for all fuels but 2 per cent of the revenues would be affected to buying CO₂ certificates abroad. That would require a modification of CO₂ Law, which specifies that tax revenues must be fully returned to the population and businesses. The third package had the necessary CO₂ tax on heating and process fuel and the climate penny for motor fuels. The fourth package, finally, contained only the climate penny on motor fuels, but at a higher rate to buy CO₂ certificates in order to cover the full Swiss Kyoto commitment. It was understood that the last two packages were compatible with CO₂ Law.

At this point, it is important to note that Parliament can choose to ignore its own laws or modify them and has done so in the past. There is no Supreme Court that could prevent that in Switzerland. Several 'safety valves' in the CO₂ Law could be used to justify such a move, in particular the reference to weak environmental efforts or low fuel prices in other countries and to international competition.

At the end of the consultation process, the Federal Council decided to propose the third package to Parliament, i.e. to accept the climate penny as a declaration of self-regulation covering motor fuels. It signed an agreement with the Climate Penny Fund, created in 2005 as a private foundation, which sets the following targets: the Fund must reduce CO₂ emissions by 1.8 million tonnes over 2008-2012, of which at least 0.2 million tonnes inland. There is no obligation beyond 2012. The agreement is temporary: should the Fund's business plan at the end of 2007 fail to meet the targets, the Federal Council could still propose to Parliament a CO₂ tax on motor fuels.

The climate penny is collected since October 1, 2005 (in fact 0.015 CHF/litre). That yields about CHF 100 million per year for the Fund, which may decide freely how to use that money. It announced that it would spend about 30 per cent of it to purchase carbon certificates abroad and 70 per cent inland, in particular to subsidize the insulation of buildings and other projects submitted in repeated calls for proposals. The first calls were made mid-2006.

Will There Be a CO₂ Tax on Heating and Process Fuel?

After the Federal Council's decision to propose the third package with a CO₂ tax on heating and process fuels, a major perturbation shuffled the cards: the strong rise in oil prices on world markets in the summer of 2005. That gave momentum to long-time opponents of a CO₂ tax (in effect of any climate policy), who could claim that the higher fuel prices would lead to sufficient energy conservation and CO₂ abatement. Indeed, the earlier forecasts about CO₂ emissions were built on much lower oil price scenarios. A solution would be to set a flexible tax, which would sink when oil prices rise, but presently a strong coalition in Parliament wants to scrap the CO₂ tax altogether.

Soon after the climate penny was approved and implemented, the main association of property owners came up with a proposal to create a similar fund that would be fed by a penny levied on heating oil and that would subsidize energy conservation in buildings. That proposal was nearly accepted by the lower chamber of Parliament. It finally decided in June 2006 to introduce a tax on heating and process fuels of CHF 12 per tonne CO₂ in 2008, to be raised to CHF 24 in 2009 and CHF 36 in 2010 (the same rates as

in the 1994 proposal!), unless the intermediate targets for CO₂ emissions are met. This proposal will soon be submitted to the higher chamber of Parliament.

The firms and energy agencies that prepared and signed declarations of self-regulation are strangely silent. Those declarations are not legally binding. There would only be a moral pressure on their signatories to keep their pledge if they contributed to avert the tax. That pressure would be very soft if no CO₂ tax were implemented at all. The firms could easily invoke unforeseen changes in economic conditions, so it must be expected that the promises will not be kept.

CONCLUDING ASSESSMENT

The unravelling of a good approach

Thanks to the climate policy architecture, one-fourth to one-third of the Swiss economy made serious declarations of self-regulation in order to reduce CO₂ emissions. Many firms made them in the blind hope that those declarations could suffice to guarantee that the reduction target would be met without implementing a CO₂ tax. Many firms expected to get a better deal when the tax was introduced. Many firms pledged out of concern for climate change, air pollution and energy dependence. In any case, much was learned about technical solutions for fossil fuel conservation and we would say that broad consensus was built in the industry for an effective climate policy. We even saw the emergence of a constituency for a CO₂ tax, either to benefit from its exemptions or simply because proof had been given that tailor-made self-regulation on a decentralised basis was extremely expensive in terms of transaction costs.

Still, that gradual process to building consensus for a CO₂ tax is unravelling, because two broad sectors were left out, the transportation sector and the property sector. Those sectors are too fragmented to commit on self-regulation. However, they possess powerful lobbies that came up with alternative proposals. Instead of reducing their own CO₂ emissions, they would impose a very small price increase passed on their consumers, in order to pool huge financial resources to buy cheap certificates abroad. Pennies on their fuel consumption seem sufficient to buy certificates equivalent to the emissions reductions that could only be obtained domestically with strong price increases, considering the small elasticity of transportation and heating fuel demand.

The penny proposals invoke efficiency – CO₂ emissions reductions can be obtained at much lower resource costs worldwide, compared to relatively

energy efficient Switzerland. They even invoke equity, or the inequity of charging high CO₂ taxes on tenants and commuters who have but little opportunity to reduce their fuel consumption. Those forceful proponents of the penny proposals leave out the ancillary benefits of domestic CO₂ emissions reductions; the fact that energy prices would remain far from full internalisation of external costs; and the fact that all those who made and make efforts to reduce their fuel consumption would benefit from the redistribution of the revenues of the CO₂ tax. They also leave out the transaction costs and subsidy-induced distortions caused by their proposals, particularly as they would be the main beneficiaries of the private bureaucracy they propose to set up. In short, a noisy minority threatens to distort climate policy in its own interest at the cost of a silent majority that will miss the recycling gains of the CO₂ tax and continue to suffer from air pollution.

Lessons to be learned

The authorities tried to impose a CO₂ tax in the early 1990s, but had to back down. They proposed to leave time for voluntary approaches and to keep the tax as a background threat written in a Law. However, opponents of any form of climate policy managed to weaken that threat. They introduced ‘safety valves’ into the Law that could be invoked to back off when the threat must be exercised. They also gave Parliament a final say before introducing the tax. To be credible, the exercise of the sanction must be automatic when a quantifiable intermediary target is missed. Legal automatisms are hard to implement in democracies, but they exist in areas outside of environmental policy, for example, in the form of ceilings on public spending and deficits. Even legal automatisms are insufficient when there is no Supreme Court that can tie a government and a parliament to its own laws.

In those cases where governments cannot credibly commit, policies built on threat are doomed. They must be replaced by policies gradually building a consensus for tougher measures. An unexpected side effect of leaving time for voluntary approaches was to build such a consensus in the industry sector. However, the main fossil energy users – transportation and heating – were left out. Majorities in those sectors should still support the CO₂ tax whose proceeds are fully returned to them. Indeed, all citizens who use less heating oil and less motor fuel than average would benefit from the CO₂ tax. The Swiss experience also shows that full recycling of revenues is not sufficient to make a green tax acceptable. It is often not fully understood, citizens seeing the daily price increase much more vividly than the check that comes one year later. An analysis of a referendum on three energy tax proposals held in Switzerland in September 2000 showed that the proposal that

recycled revenues through subsidies to energy conservation fared better than the proposal that fully returned the tax revenues to the citizens (Thalmann, 2004). The first CO₂ Law proposal provided for such targeted recycling, but it was defeated on principle grounds – no new energy subsidies sprinkler – before it even came before the voters.

Examining how a country sets up its climate policy teaches a lot about the workings of its political system. It shows also that climate policy must be tailored to the political system.

NOTES

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1. The Netherlands followed a similar approach. There is only a very low energy tax for small energy consumers. Large consumers sign negotiated agreements with the government to obtain licensing for plants and, for some, against the promise that the government would not introduce a serious energy tax (Glasbergen, 2004).
2. Mol, Lauber and Liefverink (2000) gather many comparative contributions on participatory law making in the environmental field in Austria, Denmark and the Netherlands.
3. For additional information on Swiss energy policy and situation, see <http://www.umwelt-schweiz.ch/buwal/eng/medien/umweltbericht/index.html>. For a survey of Swiss energy consumption, see <http://www.energie-schweiz.ch/internet/02065/index.html?lang=en>. Unless indicated otherwise, this section uses statistical information from <http://www.climate-reporting.ch>, in particular SAEFL (2001), as well as general economic and demographic data from the Swiss Federal Statistical Office.
4. On the other hand, the modified CO₂ accounting should subtract domestic emissions linked to the production of exported goods (SAEFL, 2000).
5. 1 PJ = 10¹⁵ Joules.
6. Apart from Kram and Hill (1995), we are not aware of studies assessing the marginal abatement cost for Switzerland, in comparison with other countries, by using the same model. We thus avoid here to quote a precise value for marginal abatement cost, since it strongly depends on the model used and corresponding assumptions. For instance, according to model used, the marginal abatement costs in 1990 US\$/tC to reach the Kyoto target varies from 76 to 410 in the USA, from 20 to 966 for the OECD-Europe, and from 97 to 1074 for Japan (for a survey and discussion, see, for example, Intergovernmental Panel on Climate Change (IPCC), 2001).
7. The Federal Council proposed to demand a smaller reduction from motor fuels on the basis of models that showed that a 10 per cent reduction would be highly unlikely in the face of growing transport demand. In fact, it had initially only demanded a 5 per cent reduction for motor fuels, but that target was tightened in compensation for excluding the rapidly growing consumption of airline fuels from the total.
8. The energy policy based on the Law on energy sets an explicit CO₂ target and the environmental protection law is the umbrella under which some GHGs (HFC, PFC, SF₆) are addressed as hazardous substances.
9. CHF = Swiss Franc. The Swiss Franc is worth about US\$0.75 or Euro 0.65.
10. The Swiss Administration for the Environment, Forests and Landscape (SAEFL) calls the declarations of self-regulation 'agreements' and the negotiated agreements 'formal

commitments'. For the moment, the details of both types of voluntary approaches are defined in a Guideline (SAEFL, 2001), but if the CO₂ tax is implemented, the negotiated agreements will be defined by the same Ordinance as the tax. A Guideline contains more than recommendations, but it is less binding legally than an Ordinance. It is possible to be granted exceptions from a Guideline, but they must be justified. The Ordinance will be necessary for the negotiated agreements, while the Guideline is sufficient for the declarations of self-regulation.

11. Particle filters are not mandatory for diesel engines in Switzerland.
12. Remember that the Federal Council may well decide to implement the CO₂ tax for one sector only.
13. The tax rate increases to reflect over-proportional increase in marginal abatement cost. Tax revenues are used in the simulations to reduce social security contributions. The estimated impacts on Swiss GDP are negligible, even slightly positive for employment. In comparison, the CO₂ Law sets a ceiling at CHF 210 per tonne of CO₂, while revenues are recycled somewhat differently (see above).

REFERENCES

- Arquit Niederberger, A. (2005), 'The Swiss Climate Penny: An innovative approach to transport sector emissions', *Transport Policy*, **12**(4), July, 303-13.
- Bahn, O. (2001), 'Combining policy instruments to curb greenhouse gas emissions', *European Environment*, **11**, 163-71.
- Bahn, O., E. Fragnière and S. Kypreos (1998), 'Swiss energy taxation options to curb CO₂ emissions', *European Environment*, **8**, 94-101.
- Bahn, O. and C. Frei (2000), *GEM-3 Switzerland: A Computable General Equilibrium Model Applied for Switzerland*, Paul Scherrer Institute (PSI), General Energy Research Department, PSI Bericht Nr 00-01.
- Baranzini, A. and S. Ruetten (1998), 'The Swiss climate policy: On the way to mitigation and prevention?' International Academy of the Environment, *Working Paper W 59*, Geneva.
- Baranzini, A., P. Thalmann and C. Gonseth (2004), 'Swiss Climate Policy: Combining VAs with other Instruments under the Menace of a CO₂ Tax', in A. Baranzini and P. Thalmann (eds), *Voluntary Approaches in Climate Policy*, Cheltenham, UK and Northampton, MA, USA: Edward Elgar, pp. 249-76.
- Bjørner, T.B. (2004), 'An Empirical Analysis of the Effect of the Danish Energy Agreements', in A. Baranzini and P. Thalmann (eds), *Voluntary Approaches in Climate Policy*, Cheltenham, UK and Northampton, MA, USA: Edward Elgar, pp. 277-97.
- Brau, R. and C. Carraro (2004), 'Voluntary Approaches as Climate Policy Tools: Competition Issues and the Role of Market Structure', in A. Baranzini and P. Thalmann (eds), *Voluntary Approaches in Climate Policy*, Cheltenham, UK and Northampton, MA, USA: Edward Elgar, pp. 89-104.
- de Muizon, G. and M. Glachant (2004), 'The UK Climate Change Levy Agreements: Combining Negotiated Agreements with Tax and Emission Trading', in A. Baranzini and P. Thalmann (eds), *Voluntary Approaches in Climate Policy*,

- Cheltenham, UK and Northampton, MA, USA: Edward Elgar, pp. 231-48.
- DFI (1994), *Taxe CO2 Prélevée sur les Agents Energétiques Fossiles. Rapport Explicatif*, Département Fédéral de l'Intérieur, Berne.
- EnAEc (2003), *Bilan de l'AenEC au 1er Trimestre 2003. Chiffres Officiels*, Energy Agency for the Economy, Zurich.
- Glasbergen, P. (2004), 'The Architecture and Functioning of Dutch Negotiated Agreements', in A. Baranzini and P. Thalmann (eds), *Voluntary Approaches in Climate Policy*, Cheltenham, UK and Northampton, MA, USA: Edward Elgar, pp. 170-88.
- Intergovernmental Panel on Climate Change (IPCC) (2001), *Third Assessment Report - Climate Change 2001*, Cambridge, UK: Cambridge University Press.
- Jochem, E. and M. Jakob (eds) (2004), *Energieperspektiven und CO2-Reduktionspotenziale in der Schweiz bis 2010*, Zürich: vdf Hochschulverlag der ETH Zürich.
- Kram, T. and D. Hill (1995), 'A multinational model for CO2 reduction. Defining boundaries of future CO2 emissions in nine countries', *Energy Policy*, **24**(1), 39-51.
- Krarp, S. and S. Ramesohl (2002), 'Voluntary agreements. Key to higher energy efficiency in industry', in P. ten Brink (ed.), *Voluntary Environmental Agreements. Process, Practice and Future Use*, Sheffield: Greenleaf Publishing, pp. 297-312.
- Langpap, C. and J. Wu (2004), 'Voluntary Approaches under Uncertainty and Irreversibility', in A. Baranzini and P. Thalmann (eds), *Voluntary Approaches in Climate Policy*, Cheltenham, UK and Northampton, MA, USA: Edward Elgar, pp. 143-56.
- Lyon, T.P. and J.W. Maxwell (2004), 'Public Voluntary Programmes for Mitigating Climate Change', in A. Baranzini and P. Thalmann (eds), *Voluntary Approaches in Climate Policy*, Cheltenham, UK and Northampton, MA, USA: Edward Elgar, pp. 126-42.
- Mol, A., V. Lauber and D. Liefferink (eds) (2000), *The voluntary approach to environmental policy : joint*

environmental policy-making in Europe, New York: Oxford University Press.

Prognos (2002), *Standortbestimmung CO₂-Gesetz. CO₂-Perspektiven und Sensitivitäten*, Swiss Administration for the Environment, Forests and Landscape, Basel.

SAEFL (2000), 'Graue Treibhausgas-Emissionen des Energie- und des Ernährungssektors der Schweiz 1990 und 1998', Swiss Administration for the Environment, Forests and Landscape, *Umwelt Materialien* 128, Bern.

SAEFL (2001), *Third National Communication of Switzerland to the United Nations Framework Convention on Climate Change (UNFCCC)*, Berne: Swiss Administration for the Environment, Forests and Landscape.

Thalmann, P. (2004), 'The public acceptance of green taxes: 2 million voters express their opinion', *Public Choice*, **119**(1-2), April, 179-217.

Thalmann, P. and A. Baranzini (2004), 'An Overview of the Economics of Voluntary Approaches in Climate Policy', in A. Baranzini and P. Thalmann (eds), *Voluntary Approaches in Climate Policy*, Cheltenham, UK and Northampton, MA, USA: Edward Elgar, pp. 1-30.

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