CURRENT EXPERIENCE WITH SUPPORTING WIND POWER IN EUROPEAN ELECRICITY MARKETS

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ABSTRACT
The EU has experienced a large increase of wind power over the last two decades due to several factors. This paper discusses the performance of support mechanisms to promote renewable energy, particularly wind power, in the European markets. The paper starts with introduction of current policy framework in the EU, and then it makes an overview of different support mechanisms applied now in 15 Member States, identifying trends in their development. The paper pays particular attention to Germany, where the most notable expansion of wind generation has taken place.

1 POLICY FRAMEWORK

One of the main drivers for the development of renewable energy in general and wind power in particular is the constant increase of the EU dependence on the import of energy resources. The EU currently imports some 50 % of its requirements; a figure that will rise to about 70 % in 2030, with an even greater dependence on oil and gas, if current trends persist. It cost the Union some € 240 billion in 1999, or 6 % of total imports and 1.2 % of GDP [1].

Other driving forces for expansion of renewables include:

- Reduction of greenhouse gases and pollutant emissions, and their climate change effects,
- Sustainable development,
- Creation of local employment,
- Social-economic cohesion,
- Development of European industry.

A legal framework for the exploitation of the renewable energy sources (RES) is ensured by the "Directive 2001/77/EC of the European Parliament and the Council on the Promotion of Electricity Produced from Renewable Energy Sources in the Internal Market". The Directive sets a Community target of sourcing 12% of gross inland energy consumption from RES by 2010, with an indicative figure of 22.1 % for electricity. It also sets indicative targets for each Member State. Furthermore, the Directive obliges Member States to:

- publish a report on meeting the national indicative targets;
- issue guarantees of origin of electricity produced from RES;
- assure guaranteed access for electricity produced from RES;
- ensure transparent and non-discriminatory costs for connection of producers of electricity from RES to the grid.

The Directive recognises the need for public support for RES, but does not require the immediate establishment of Community-wide framework regarding support mechanisms. At present, Member States operate different mechanisms at the national level and the Directive aims at guaranteeing the proper functioning of these mechanisms in order to maintain the investor confidence.

The Commission is tasked to evaluate the application of mechanisms used in Member States according to which a producer of electricity receives direct or indirect support. Based on the Member States reports, the Commission will present to the European Parliament and the Council, no later than 27 October 2005, a well documented report on experience gained with the application and coexistence of the different mechanisms. The report will assess the success, including cost-effectiveness, of the support systems in promoting the consumption of electricity produced from renewable energy sources in conformity with the national indicative targets. If necessary this report will propose a Community-wide support scheme for RES. The Directive stipulates that the proposal should include among other aspects sufficient transitional periods for national supports systems of at least seven years and maintain investor confidence [2].

2 OVERVIEW OF INCENTIVES FOR WIND POWER IN THE EU

The chapter considers requirements to policy instruments in the European wind energy sector, makes an overview of currently (beginning of 2004) applied ones and discusses trends in their development.

2.1 Requirements and criteria

A number of mechanisms are in force to support wind power development in European markets. In order to better understand and evaluate their performance the following requirements and criteria are discussed below:

- Effectiveness
  Effectiveness should determine the performance of a support mechanism in relation to the objective achievement. The latter is defined by the European Commission as an increase of the penetration of the

RES. In this case, the performance of support instruments can be measured in MW of installed capacity or MWh of electricity generated from RES (RES-E).

- Efficiency
  The objective should be achieved with the most possible effective use of capital, which requires a transparent and simple mechanism to be acceptable and minimize administration costs. This criterion considers the performance of a support mechanism in relation to the costs associated with the achievement of the objective and can be expressed in €/MW and €/MWh.

- Cost reduction
  Support mechanism should continuously stimulate technical development of the installations for electricity generation, which can be achieved by adjustment of the support level to the generators according to the technological and market situation, preventing at the same time inadequately high payments. The further technical development facilitates the reduction of the expenditures of manufactures and therefore their market position and the costs of electricity generation.

- Market compatibility
  Ideally, a support mechanism should be based on market forces, to facilitate easier transition of the supported technology to the pure demand-driven market environment, to drive costs down and to transfer the benefits of cost-reducing efficiencies to customers.

- Burden sharing
  It is absolutely important to distribute costs and benefits of the implementation of a support mechanism fairly in order not to disturb market positions of players.

- Industry and labour development
  Support mechanisms may also stimulate the development of industry and labour market. The industrial progress of a certain technology and the development of associated markets are of a particular importance for the establishment of the sustainable development and the increase of export. Moreover, the support of new energy technology positively influences the increase of employment.

- Local acceptance
  Acceptance aspects are one of the success factors for the contribution of market support mechanism to a sustainable development of renewable energy sector. It is important to provide and maintain sufficient acceptance of the local population. This can be achieved by early information of the population and important social groups about the overall economic and environmental advantages of the renewable technologies and their participation in supported projects as partners and operators.

- Certainty for investor
  It is clear that for the achievement of the targets set for the development of renewable energy, it is necessary to attract investors. Investment decisions depend both on the level of payment for renewable energy and the stability of support mechanisms. Continuously changing mechanisms generate uncertainty and risk for the investor. Therefore, in order to ensure the planning and financing security of the supported sector, an obligatory minimum period of validity – normally for the establishment of a new technology at the market – is necessary.

2.2 Overview and trends

According to the principle of subsidiarity the EU Directive does not require a Community-wide framework for all the Member States, therefore different national mechanisms are in use. The table 1 gives an overview of the currently applied mechanisms (marked with √), pointing out dominant ones (hatched background).
The penetration of RES into electricity markets depends on the supply of and demand for RES-E, as well as on market support mechanisms. Therefore, for the further analysis, a distinction between the mechanisms on the supply and demand side should be made. The supply of renewable energy is stimulated by mechanisms

supporting investments and production. The demand for the electricity from RES is promoted by mechanisms aimed at consumption.

Support mechanisms on the supply side:

- Feed-in tariffs (FIT) are a minimum guaranteed price or a premium in addition to market electricity price per unit of electricity produced from RES paid to domestic producers. This mechanism is usually accompanied by the obligation put on network companies to take and pay compensation for such electricity; the costs are then distributed to final customers. The fixed price or fixed premiums are set for a number of years to maintain investor confidence and can be revised and adjusted by governments to reflect long-term marginal generation costs and stimulate costs reduction. Feed-in tariffs are in use in 12 out of 15 EU countries, notably in Germany, Spain, France and Denmark.

Table 2-1: Support mechanisms for wind power in the EU as of 01/04

	Supply support					Demand support		
Country	FIT	Quota	Investment support	Fiscal support	Tendering	Quota	Fiscal support	Green pricing
Austria	√			√				√
Belgium	√			√		√		
Denmark	√		√	√		√		
Finland	√		√	√				√
France	√				√			
Germany	√			√				√
Greece	√		√					
Ireland					√			
Italy	√	√	√					
Luxembourg	√		√	√				
Netherlands	√						√	√
Portugal	√		√					
Spain	√							
Sweden				√		√		
UK			√	√		√	√	√

- Quota-based systems are driven by regulatory imposed obligation on producers and importers of electricity to produce a certain share (quota) of RES-E. To fulfil its obligation a producer can install new RES capacity to produce RES-E or buy required amount of RES-E by means of tradable green certificates. The certificates provide an instrument for production monitoring, accounting and transfer of RES-E. In case of incompliance, the producer will have to pay a penalty, which value is set by government. This mechanism is currently applied in Italy.
- Investment support is the earliest mechanism used to promote renewable energy, by means of compensation up to 50% of capital cost of a new installation. This instrument is still used to stimulate investments mainly in more expensive renewable energy technologies; nevertheless, wind power projects also receive subsidies in some cases. The mechanism has a number of advantages – it is simple, market compliant, easy adjustable to applied technology, capacity, geographical and market conditions. However, the support for capital investment, as well as other capacity-based instruments, does not stimulate cost-effective operation of renewable energy installation.
- Fiscal support may take different forms and is applied directly or indirectly to stimulate supply of RES-E in several Member States. Some tax advantages, for instance exemption of RES-E from energy taxes by using a tax relief per kWh generated stimulates the supply of RES-E from both new and old installations.

The other options, for instance lower VAT rates on RES installations, are similar to investment subsidies and affect only new installations. Fiscal support could also be related to company profit tax. For instance, allowing a quicker depreciation of assets reduces a company's profit and therefore the profit tax. Energy tax and CO2 taxation for conventional electricity are considered below in the section of the support mechanisms for demand stimulation.

- Tendering system, which is used in the Republic of Ireland, involves a series of tendering competitions, where prospective investors or generators compete among each other based on the bid price per kWh. Successful competitors are offered long-term power purchase agreements. The excess costs of power purchase from RES projects are passed through a levy on all electricity customers. The competition mechanism leads to the selection of the most cost-effective options; however the associated administration costs tend to be rather high.

Support mechanisms on the demand side:

- Quota-based system with obligation on supply or consumption. It is built on the same mechanism as the quota obligation for electricity produces, while it is applied to other actors in the electricity supply chain – distributors, suppliers, and consumers. The system is now introduced in the UK, parts of Belgium, Denmark and Sweden.
- Fiscal measures – energy tax or CO2 taxation increases the cost of conventional electricity, which indirectly benefits RES-E thus stimulating demand for it. In the Netherlands in 2002, the taxation system on energy combined with a stimulation of renewable energy consumption, allowed prices from renewable electricity to approach or match that of grey electricity for the household sector. This created a large demand for energy from renewables, but due to the uncertainty of continuity of the instrument and international competition, it did not lead to a matching increase in installed capacity [3].
- Green power marketing is a voluntary approach based on the 'willingness to pay' of private individuals, and commercial or industrial companies. Nowadays 'green pricing' with open-market 'green tariffs' is the most common voluntary instrument to promote electricity from RES. The core feature of this mechanism is that participants are willing to pay a premium price per kWh above the regular tariff rate. These voluntary initiatives can be supported by favourable regulatory environment. Nevertheless, only few customers have switched.

Trends:

Over the past years, a lot of experience has been gained with a variety of mechanisms for wind power support. First mechanisms of financial support, in the form of capital grants, loans or reduced taxes appeared in the early 1980s to encourage installation of generating plant. The most successful examples were in Germany and mainly Denmark, where, for instance, it was possible to obtain preferential real estate loans for wind turbines [4]. Later feed-in tariffs have become more popular, which included a guaranteed price per kWh set by authorities or determined for projects under a tendering system.

The electricity markets liberalisation process at the end of 1990s facilitated the establishment of demand support mechanisms. The customers' ability to choose a supplier enabled the establishment of voluntary mechanisms, such as Green Pricing.

At present, a general trend towards two main support mechanisms – feed-in tariffs and quota obligation with tradable green certificates can be observed. The following table compares these mechanisms quantifying their performance (as of January 2004) according to several criteria set in the section 2.1.

Table 2-2: Comparison of mechanisms' performance

Support mechanism	Country	Effectiveness (in MW of capacity installed)	Incentive for new installations (€ / MWh) [5]	Induced employment in wind energy sector [6]
Feed-in tariffs	Germany	14,000	59 – 88	~ 45,400
	Spain	5,780	62,1	~ 20,000
Quota obligation	UK	648	~ 94	~ 3,000
	Italy	820	~ 130	~ 2,500

The underlying of the mechanisms' performances is the certainty to investor, which is far less in the quota-based instruments in comparison with the feed-in tariffs. The difficulty with the first one is inability to predict future value of green certificates with a high degree of certainty. For investors it means either the investment decision may not be made, or, if it will be, it will require higher returns to compensate higher risk. Therefore, not that many wind power projects are being developed as it was expected.

Feed-in tariffs are often criticized not to be efficient, while quota-based instruments based on market forces were expected to cost less. Nevertheless, most quota obligation mechanisms are fairly new and their success is certainly not proven yet and due to the factors mentions above they can cost even more. The fact is that experience with feed-in tariffs has confirmed their extremely effective performance.

3 EXPERIENCE WITH WIND POWER SUPPORT ION GERMANY

Feed-in tariffs are currently applied in a number of Member States. The most remarkable expansion of wind power induced by feed-in tariffs was experienced in Germany. This chapter considers the evolution of this support mechanism, current debates and expected future development.

3.1 Tariff development

In Germany feed-in tariffs were introduced since January 1, 1991 when "Electricity Feed Law" came into force. It obliged the grid companies to purchase renewable electricity from eligible sources and to pay them compensation. The amount of the compensation per kWh was established annually, based on the official federal statistics for the preceding calendar year's published average price from energy sales to the end consumer. For wind power, the feed-in tariffs were fixed to "at least 90% of the average price per kWh from the electricity delivered by utility companies to all end consumers". Besides the feed-in tariff, other support mechanisms were in place: governmental subsidies, lower interest rates for loans to invest in wind turbines, tax deductions, etc. All these have successfully led to the increase of installed capacity of wind energy.

On the 1st April 2000, the Electricity Feed Law was replaced by the "Erneuerbare Energien Gesetz" (hereinafter the EEG) – "Act on Granting Priority to Renewable Energy Sources". With regard to the level of energy sales figures for wind energy, the EEG contains differentiated compensation amounts. For new plants, which commenced operation before 31.12.2001, an initial compensation of 9.1 €ct/kWh exists, for a minimum period of five years.

Depending on the location quality, the feed-in tariff level decreases to 6.19 €ct/kWh, according to the "reference yield model". The reference yield, according to the EEG, is the annual energy yield that a wind turbine provides at a so-called reference location. The reference location is defined for one wind regime (Rayleigh distribution) as 5.5 m/s average annual wind speed at a height of 30 m and a roughness length of 0.1 m [7].

At locations with strong yield, the decrease may take place immediately after the completion of the fifth year. At locations with weaker yields, the initial level of feed-in tariff may be paid for up to 20 years. Compensation payments are guaranteed for the period of 20 years regardless the quality of location.

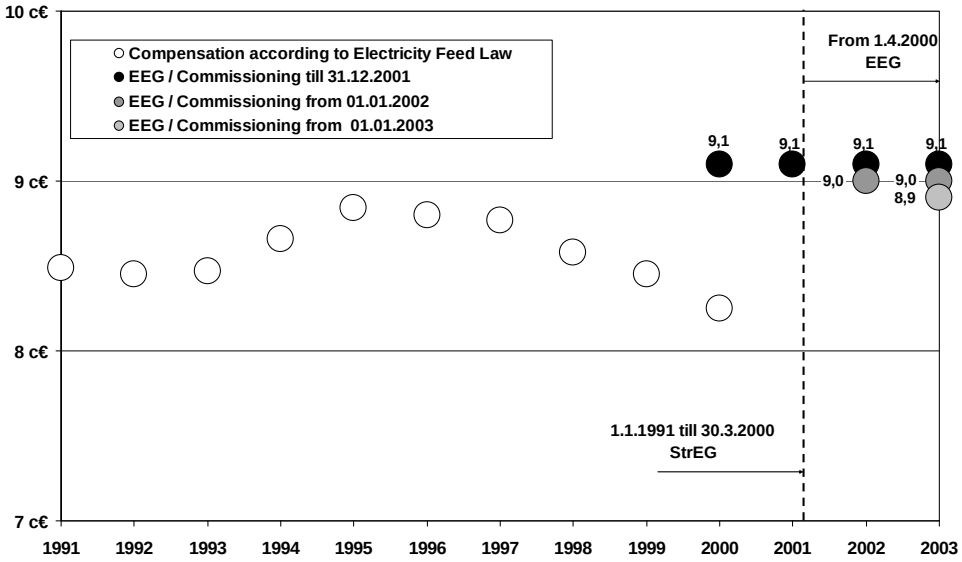

Figure 3-1: Development of feed-in tariffs in Germany for wind power

Variable feed-in tariff for old installations

In accordance with the EEG, all wind turbines that began operation before 01.04.2000 are subject to the so-called "Altanlagenregelung" (Old Plants Regulation). According to this regulation, the period of high rate payment (9.1 ct€/kWh) is fixed to at least four years. It can be extended in relation to location quality.

Variable feed-in tariff for new installations

The regulations concerning the level and duration of the feed-in tariff, also applies for wind turbines that began operation after the commencement of the EEG (01.04.2000). But the minimum compensation from the 1.1.2002 is "decreased each year by 1.5% for each newly operating plant from this point in time". Therefore, the minimum compensation levels for plants which began operation in 2002 laid at 9.0 and 6.1 ct€/kWh, for plants beginning operation in 2004 at 8.8 and 5.9 ct€/kWh.

3.2 Current discussions

Despite of the fact that the EEG has proved to be very effective instrument, it is constantly being criticised to be inefficient, market incompatible, etc. The main discussion issues are summarized below.

Cost reduction

The feed-in tariffs are being mainly blamed for non-efficiency in driving down costs, since they are not based on direct competition. Nevertheless, wind power market research proves the opposite – a learning curve indicates a "progress ratio" of 89%. The figure 2 depicts the specific price per kWh annual yield of the reference yield (see section 3.1).

The following values result from calculations for this learning curve: with approx. 60 MW cumulative power in 1990, approx. 0.84 €/kWh annual energy yield of the reference yield. For 2002 the price level lay at around 11,400 MW cumulative power real, about 0.38 €/kWh annual energy yield of the reference yield. This corresponds to a price reduction of around 11% per doubling step [8].

Another market analysis [9] states the reduction of wind power project costs by 7% and turbine prices by 9% between 1998 and 2001.

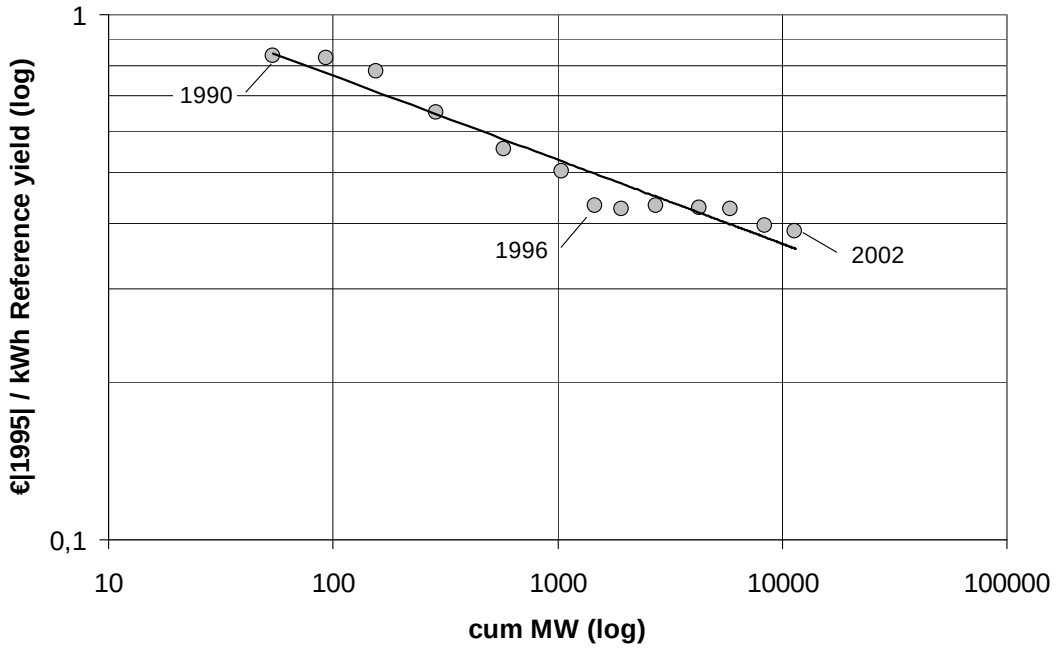

Figure 3-2: Wind energy experience curve in Germany

Additional costs

Wind power being an intermittent energy source brings about extra costs associated with its integration into power system. These costs are a stumbling-block of debates with three of four German transmission system operators (TSOs) accommodating the most of wind power in their control areas. It is obvious that the increase of wind generation share in an electric system inevitably requires larger power reserves. But how far need they be enlarged? The German TSOs claim that the country's wind power plant needs reserves equal to half their installed capacity. This is up to ten times more then needed in other countries [10].

The federal cartel office investigates now the affair of the TSOs charging inexplicably high costs of balancing power and announces that the merge of the control areas would significantly improve liquidity on the balancing market and accordingly drive down the costs.

The German energy agency DENA has recently started a new study to examine the key issues of wind energy integration such as reserve requirements, grid reinforcement and system stability.

Energy-intensive industry

Although the cost of feed-in tariffs equally distributed on and paid by final customers was only about 0.0021 €/kWh in 2003, energy-intensive industry declared that it suffered strongly from this burden. Many discussions of large industrial companies with the government have lead to the introduction of "hardship" clause. Under this measure, companies that consume at least 100 GW/year and whose electricity costs equal at least 20% of net turnover have been granted one year period of relief from an increased renewable energy levy. The clause will be made more long-term in the planned amendment to the EEG.

Market incompliance

The condemnation of the feed-in tariffs to be market incompliant is based on one of the basic mechanism's features – to protect wind power projects from market risks. The opponents see the feed-in tariffs unable to cope with specific demands of green electricity customers and to prepare market parties for aspects of competing in a free market. The feed-in tariffs do not induce competitive pricing between generators, which may result in less efficiency.

However, the EEG prescribes a gradual imposing of market risks by the annual tariff reduction, which stimulates technological and organizational development. Therefore, the mechanism's design makes provisions for a steady transition to market conformity.

Another aspect being criticized is that feed-in tariffs conflict with the EU rules of the internal market creation, non-discrimination of domestic versus foreign producers and free international trade between Member States in that they limit support to renewable generation only at domestic level, and do not apply to imported electricity generated under equal conditions. Nevertheless, the European Court of Justice has ruled the German provisions for feeding power from renewable sources into the grid "do not constitute State aid" nor do they breach the EU regulations on "free movement of goods" [11].

Low-wind sites support

The today's capacity of 14 GW has occupied the majority of locations with good wind resource, leaving the quality of wind sites being developed now to decline. The further wind power expansion over the next couple of years, before going offshore, is going to come from low-wind sites. The current tariff structure with guaranteed 20 years period of high rate payment for such sites enables their forthcoming. But the German government is reluctant to support it and will decide how to increase wind energy inland not overpaying for it, on the one hand, and preventing market from collapse on the other.

Offshore development

The quality reduction of inland wind sites and currently limited potential for repowering makes Germany to go offshore to expand its wind generation portfolio. According to the strategy of the Federal Government, in a long-term, by 2025-2030, it is possible to cover 15% of the electricity demand (of 1996) from offshore wind, installing a capacity of 20-25 GW in the North and Baltic Seas.

The EEG in its present edition stipulates that electricity produced by offshore wind will be compensated by 9.1 €ct/kWh for the first 9 years and 6.19 €ct/kWh thereafter. However, it is somewhat complicated to estimate now the costs and the level of support needed for electricity generation by the future offshore wind farms.

3.3 Future developments in Germany

The above mentioned debates and other issues have led to an amendment to the EEG, which may come into force this year. The act introduces the main following changes for wind energy:

- Reduction of the base payment for onshore installations by 0.5 €ct/kWh to 5.5 €ct/kWh in 2004 (it was 6.0 €ct/kWh in 2003 and 5.9 €ct/kWh in 2004);
- Reduction of the high rate for onshore installations by 0.1 ct/kWh to 8.7 ct/kWh in 2004 (it was 8.9 ct/kWh in 2003 and 8.8 €ct/kWh in 2004);
- Annual reduction of payment rates by 2% (1.5% hitherto);
- Cancellation of payment for onshore installations on low-wind sites with reference yield less then 65%;
- Extension of the high rate payment period for offshore installations to 12 years (9 years hitherto) with further extension with the distance from shore and water depth;
- Extension of the deadline for the high rate payment applicability for offshore installations to 2010 (2006 hitherto);
- "Hardship" clause applicability to industries with minimum electricity consumption of 10 GW/year (100 GW/year hitherto) and electricity costs of 15% (20% hitherto) of net turnover;
- Increased transparency.

4 CONCLUSIONS

Among different national support mechanisms applied in the European countries, feed-in tariffs have provided the most stable investment conditions and their clear advantage is in increasing installed capacity. The reduction of payments in FIT gives incentive to reduce costs. From the above discussions, it is obvious that feed-in tariffs are a transitional mechanism to ensure secure market take-off. On a longer run however, the mechanism goes through a number of disadvantages. A part of them can be solved by amendments to the current feed-in tariff regulations, but a market mechanism based on trade and competition is at some stage inevitable.

Making an overview over the past experience, it can be concluded that the strength of the wind blowing alone does not bring much wind power on-line if there is no stable investor confidence. The latter in its turn depends on the market support mechanisms' design. Only adequate incentive level and stability of rules will induce sufficient investments in the wind energy sector.

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