

## The Regulatory Challenge of Asset Valuation: A Case Study from the Brazilian Electricity Distribution Sector

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### INTRODUCTION

Given the capital intensity of network utilities, the remuneration of both historic and new investments is a major determinant of consumer prices, typically accounting for around two thirds of total costs. In order to derive the annuity required to sustain infrastructure investments over time, the cost of capital and depreciation rules are applied to the Regulatory Asset Base (RAB), a number which captures the value of all past investments in the company. The RAB used to calculate return on capital and depreciation need not necessarily be the same, as different considerations may arise in measuring the capital stock used in each case. For example, if historic investments were entirely subsidized by the tax-payer, while new investments are to be funded by the private sector, the government may choose to accept a discount on the RAB when calculating a return on historic investments (in fact many countries have done exactly this). However, even if this were to be the case, the full value of the RAB should still be used to calculate depreciation charges, ensuring that the capital stock is maintained over time.

Asset valuation often proves to be one of the most difficult and controversial aspects of regulatory

price-setting. The reason is that, where valuation cannot be related to a competitive market, no specific procedure for asset valuation is necessarily correct. Numerous conceptually consistent and properly sustained methodologies for valuing assets are available, and are widely used in differing circumstances by both the private and public sectors for a variety of reasons. Those methods routinely give widely diverging results when applied to any specific regulated company. It is not unusual to find discrepancies of 2:1—or even more—from alternative asset valuation methodologies. This evidently has a major impact on the resulting tariffs, and these high stakes—in their turn—create incentives for the different parties to the review to develop and justify opposing positions.

### **Methodological options**

Ideally, the choice of asset valuation methodology should be established in the regulatory framework at the time of privatization. Moreover, the chosen method should be adhered to consistently thereafter, as even minor methodological changes may have significant price impacts and would contribute substantially to regulatory risk for the operator since



uncertainty about returns would be introduced. Indeed, it may often be preferable to stick with a single, if somewhat imperfect methodology, than to be continuously adjusting and fine-tuning the methodology over time. Unfortunately, in practice, the asset valuation methodology is not always defined in the regulatory framework, leaving the decision pending until the first regulatory price review.

For determining the value of the underlying RAB, asset valuation methods can be characterized under two main approaches: economic value or market based and replacement cost based.

**Economic value or market based** approaches determine the value of an asset largely from its cash generating capacity. Economic value or market based approaches reflect the value of the business, as determined by investors in financial markets. This can be measured by the net present value of future cash flows (net present value) or the cash generated by selling the asset (net realizable value).

Where companies are floated, the stock price provides a continuous indication of market value. More commonly, the price obtained through public auctions at privatization provides a snapshot of market valuation at one point in time. However, it is important to note that the bid price includes the value of future efficiency gains anticipated by the bidder but unanticipated by the government. This may lead to a double dividend for the bidder if the bid price is used as the basis for asset valuation, since he benefits both from the unanticipated efficiency gain itself and from the higher resulting RAB.

When asset values are explicitly determined at privatization, it is also possible to do so by calculating the net present value of future cash flows based on the price trajectory that has been

determined for the firm (Grout, 2001). However, if not established at the beginning, this approach cannot be used at future price reviews due to a fundamental problem of circularity. The reason is that the asset value then becomes dependent on the future regulatory price path, which is in turn itself dependent on the asset value.

**Replacement cost** based approaches relate the value of an asset to the cost of purchasing the asset or the service potential embodied in the asset, either at the original historic cost or adjusting this original cost to reflect subsequent price changes. Replacement cost approaches reflect the value of assets to the business. Given the long lived nature of utility assets, the measurement of replacement cost over time is complicated by the combined effects of inflation, depreciation, and technological change. There are number of options for measuring the replacement cost of assets, which generally present a trade-off between the simplicity of the procedures involved and the accuracy of the estimates produced.

The simplest method is Current Cost Valuation (CCV), which simply takes the historic purchase price and rolls it forward by adjusting for inflation and depreciation during the intervening period.

A more sophisticated approach is the Depreciated Optimized Replacement Cost (DORC), which examines the cost of replacing each asset individually, and then adjusts for the age of the asset according to an established depreciation schedule.

A third approach to measuring replacement cost is the Reference Utility methodology, which requires the regulator to construct a hypothetical company that provides exactly the same service as the regulated company, but at an efficient cost. In

theory, the Reference Utility can be constructed from scratch, without any accounting data from the company, based only on *bottom-up* engineering and economic parameters. This can be helpful in overcoming information asymmetries and deficiencies in the accounting data. However, in practice, it is usually necessary to complement this with a *top down* approach, that starts from real accounting data but makes corrections for evident inefficiencies. The Reference Utility approach can be used to determine “efficient” values for both operational costs and the asset base required for provision of services by network industries. In a forthcoming paper, Alexander and Harris, 2004 note the particular challenges faced by asset valuation in the context of large investment programs that entail the accumulation of substantial new assets during the course of a price review period. The Reference Utility approach is flexible enough to accommodate expansions in the asset base over time, as long as it is applied over the appropriate time horizon within which the investments are scheduled to take place.

The Reference Utility approach is also known as the Gross Optimized Replacement Cost (GORC) because it results from a process of optimization that does not take the age of the assets into account. The different treatment of depreciation between the GORC and the DORC methodologies is reflected in the formula used to translate the regulatory asset base into an annuity for price-setting purposes. In the case of DORC, the company receives a rate of return on the DORC, plus a depreciation charge determined by the age of the assets. In the case of GORC, a so-called ‘sinking fund factor’ is used, which is equivalent to the annuity of a loan with a principal equal to GORC, a term equal to the economic life of the assets, and a rate of interest equal to the regulatory

cost of capital. Over time, the two methodologies should give the same revenue stream to the regulated company. However, GORC tends to provide a stable revenue stream, while under DORC the revenue stream is inversely related to the age of the assets, and therefore tends to cycle up and down. (Ironically, this means that a company with very old assets that need to be replaced, would receive a lower revenue, than a company with a brand new asset base and consequently minimal investment requirements.). The ‘sinking fund factor’ used under the GORC also avoids the creation of inequities between different generations of consumers by expressing the costs of the electricity service in the form of a stable perpetuity.

This highlights the importance of ensuring full consistency between the chosen method of asset valuation and other relevant components of the price review methodology, such as the depreciation profile. Thus, for example, a historic cost approach to asset valuation should be paired with a nominal rate of return measure, and vice versa.

### **International experience**

Every one of these methods is in active use by regulators throughout the world, and the choice between them has frequently generated substantial regulatory controversy (Byatt, 2002).

In the United Kingdom, utilities were typically sold at market values that were lower than replacement costs; around 40% lower in the case of electricity and gas, and as much as 95% lower in the case of water. As a result, British regulators have tended to adopt methodologies based on stock market value, at or near flotation, arguing that investors should only be remunerated on the basis of what they actually paid for the assets.

In Australia, where market values have tended to be higher than replacement cost, regulators are increasingly opting for the DORC methodology. However, following an appeal presented by a gas distribution company against the proposal of the gas regulator to use DORC for asset valuation, the Supreme Court ruled that the regulator should reconsider his decision. The court's verdict states that regulatory decisions should look beyond considerations of economic efficiency, to ensure that sound commercial decisions taken in the past are not rendered loss-making as a result of regulatory decisions, and that allowing a regulated business to recover the actual purchase price may be appropriate.

Furthermore, in Australia there has also been considerable debate about the asset lives to be used in determining depreciation schedules. The electricity and gas regulators have predominantly opted to extend accounting lives, based on technical studies that show that the economic lives of assets can be considerably longer. The same situation can be observed in New Zealand.

In Latin America, the Reference Utility approach has become increasingly popular for the determination of electricity distribution tariffs (Jadresic, 2002). The method, which was first developed in Chile during the 1980s, can be used to determine both efficient operating expenditures, and an efficient regulatory asset base, and as such provides an integrated approach to tariff setting. During the course of the 1990s, it has been applied in distribution tariff reviews by regulators in Argentina, El Salvador, Guatemala, Nicaragua, Panama, Peru and Uruguay. It is sometimes also used in other regulated utilities, such as gas, telecom, and water.

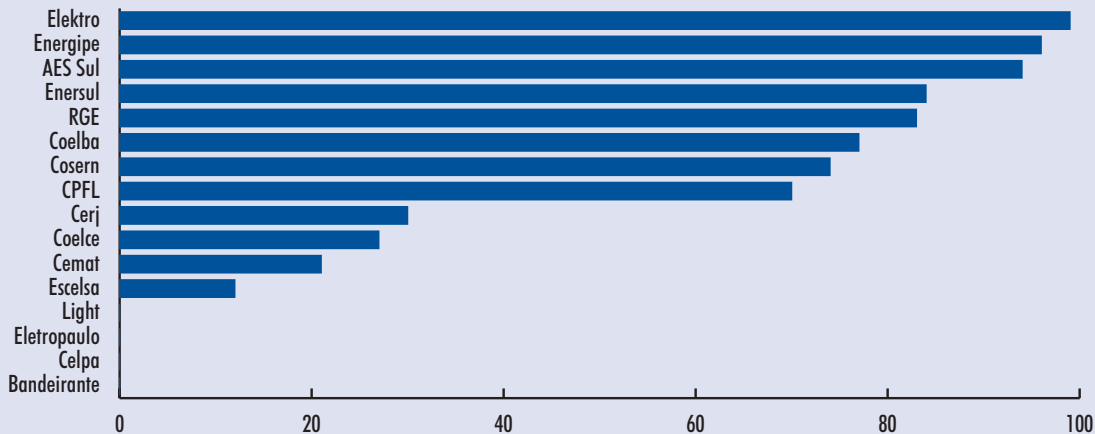
### **Brazilian electricity case**

The Brazilian electricity sector provides a particularly interesting recent example of how challenging it can be to find a suitable asset valuation methodology, in the context of a first time tariff review. A major sector reform process was initiated in 1995, which among many other measures, included the sale via private auction of 49% stakes in some 24 State electric distribution utilities, representing more than 70% of total electricity sales in the country.

In order to provide a reference point for the auctions, each State government established a minimum sale price for the respective utility, based on the results of a discounted cash flow methodology undertaken independently by two separate consultants. Due to intense competition at the auctions, the companies were sold at an average premium of 40% over and above the minimum sale price, with wide variation between 0% and 100% for the sale premiums observed in specific cases (Figure 1). Such premiums are not unusual in Latin America, with a recent study finding that a sample of six telephone companies sold for an average premium of 80% over the minimum sale price, while a sample of six electricity distribution companies, outside Brazil, sold for an average premium of 44%.

The successful bidders were awarded concession contracts of 30 years duration, to be regulated by the new federal agency ANEEL, which would also oversee the concessions granted to the remaining 40 public utilities.

Since privatization, a number of factors have combined to make the operating environment for the distribution utilities particularly challenging. First, due to difficult macroeconomic conditions, the

**Figure 1: Percentage premium of market value over minimum sale price**

Source: ABRADÉE, 2002.

Brazilian currency, the Real, devalued between 1998 and 2002 to around a third of the level prevailing at the time of privatization. Second, a major regulatory dispute subsequently arose about the arrangements for pass-through of uncontrollable expenditures, such as power purchase costs, leading to a major lag in tariff adjustments and consequential financial losses to the distribution companies. Finally, owing to a recurring drought and a number of regulatory problems that retarded the construction of new thermal plants, Brazil's predominantly hydroelectric system faced a major supply crisis in 2001. As a result, consumers were rationed to 80% of the previous year's demand, reducing distribution revenues by an estimated US\$2 billion on aggregate.

### **First round of tariff reviews**

The new legal framework provided for periodic tariff reviews to be conducted every four to five years, but was largely silent about implementation details, including the procedure for asset valuation. The only general principle established in the Brazilian

legal framework is that of preserving the 'financial and economic equilibrium' of the concession contract (as opposed to the concessionaire). However, although widely used in France, this concept has never been given a satisfactory operational definition in the Brazilian context.

This methodological vacuum became apparent in one of the first electricity distribution tariff reviews, performed for ESCELSA in the year 2001. In absence of a clear and predefined method for asset valuation, the subject became a point of major controversy between ANEEL and the concessionaire. During this review, ANEEL initially argued for a historic cost valuation of assets of R\$685m. However, this was contested by the concessionaire on the grounds that it was completely outdated. Given that by Law 9.249 of 1995 rules out the use of inflationary indices to correct asset values, the concessionaire presented two alternative estimates of replacement cost based on different accounting adjustments to the asset value. The regulator accepted the use of an adjustment based on US GAAP principles, yielding an asset value of

R\$988m, but insisted that this was a provisional measure subject to later revision once a more definitive approach to asset valuation had been determined, and that the decision in no way established a precedent for future reviews (see Technical Note No. 097/2001).

### **Asset valuation debate**

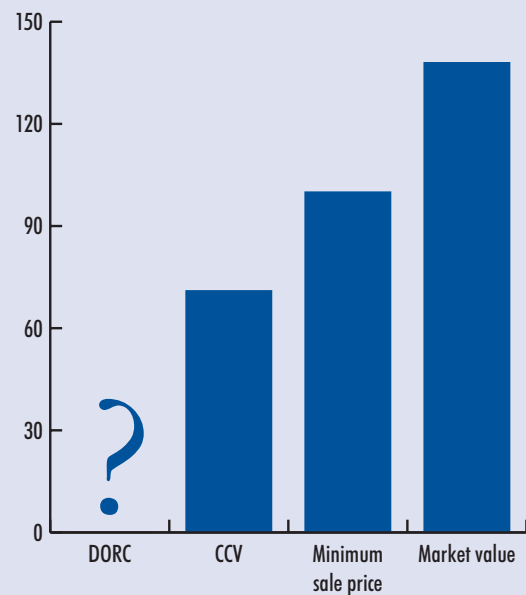
This essentially left the methodological question open for the remaining round of first reviews scheduled to take place over the period 2003/04, and in particular for the first batch of 17 reviews scheduled between February and December 2003. Thus in June 2002, ANEEL published Technical Note No. 148/2002 identifying a number of alternative approaches to asset valuation, and laying down its preferred approach.

In its note, ANEEL rejected the use of approaches based on market valuation. The reason given was that the minimum sale prices calculated in the Brazilian auctions were not determined on a consistent methodological basis, with different States making varying assumptions about discount rates, demand growth, tariffs and investment horizons. Moreover, in many cases, State governments added premiums to the discounted cash flow values in order to maximize fiscal proceeds. ANEEL also rejected the use of final auction prices, given that they incorporated a premium that reflects strategic business considerations, and were artificially inflated by the fact that the holding companies were able to obtain tax relief on the value of their acquisitions. Furthermore, given that only 24 out of 64 electric distribution utilities had been privatized, the use of market valuation did not provide a comprehensive and consistent methodology that could be applied to all the distribution companies in the sector.

Consequently, ANEEL came down on the side of replacement costs as the most defensible methodological basis for asset valuation. However, it rejected the simple CCV, arguing that this fails to take into account the effects of technological change that reduce the cost of capital goods over time. Instead, the agency opted for the more sophisticated DORC approach, accompanied by eventual benchmarking adjustments based on cross-company comparisons. ANEEL argued that, by using today's replacement cost value for comparable assets, the DORC incorporates the effects of technological change.

In the Public Audience No. 005/2002 that followed the publication of ANEEL's Technical Note, the industry association ABRADÉE opposed the

**Figure 2: Percentage divergence between valuation methods**



Notes: Based on aggregate values for a sample of 16 utilities; Minimum sale price=100.  
Source: ABRADÉE, 2002

regulator's choice for asset valuation, pointing to the wide divergence between market value and replacement cost methodologies. Based on a sample of 16 of the largest privatized distribution utilities, ABRADDEE reported that CCV was on aggregate only 50% of the actual market value paid by the concessionaires. Although no estimates of the DORC had ever been made for the Brazilian electricity distribution sector, ABRADDEE inferred that DORC could only be lower than CCV (given the adjustments made for technological change), and hence the divergence would potentially be even greater.

In an earlier statement presented to ANEEL after publication of Technical Note No 148/2002 but before the Public Audience No. 005/2002, ABRADDEE had argued for the use of the final auction price as the basis for asset valuation. However, at the public audience ABRADDEE proposed that the minimum sale price—which lies approximately half way between the final auction price and the CCV—would be the fairest alternative, because it avoids the strategic distortions that took place in the bidding process.

ANEEL countered this position by repeating its earlier arguments against the minimum sale price, and pointing out that the regulator is not legally obliged to remunerate investors, but only to ensure the financial and economic equilibrium of the concession. Notwithstanding industry opposition, ANEEL officially adopted the DORC methodology via Resolution No. 493/2002.

ABRADDEE subsequently appealed—first to ANEEL directly and later to the courts—against ANEEL's choice of replacement cost rather than minimum sale price as an asset valuation methodology. ABRADDEE asked for immediate suspension in the application of Resolution No 493/2002. However,

these attempts were unsuccessful, and by early 2003 it became apparent that the replacement cost approach would prevail.

### ***From theory to practice***

In Resolution No. 493/2002, ANEEL began to grapple with the implementation details of the DORC methodology, providing over 30 pages of practical guidelines. These established that the methodology was to involve individual documentation of each of the company's assets; although with some scope for taking shortcuts with generic smaller assets such as vehicles and furniture. This would require reconciling information in the asset register (often of poor quality), with physical inspections of assets, in some cases by sampling. Each asset was to be valued at its current sale price, adjusting for age via a linear depreciation schedule, and discounting any proportion of the asset that could not reasonably be expected to be used within the next ten years. It should be noted that this adjustment introduces an additional regulatory risk of write-off of sunk investments in under-utilized assets.

The valuation process was to be conducted by firms previously accredited by ANEEL, and subject to random quality checks by ANEEL staff. Initial estimates suggested each company valuation would take 120 days to complete. Furthermore, Article 10 of the resolution empowered ANEEL to make adjustments to asset valuations for specific companies based on benchmarking of efficiency across companies, although no further clarification was provided as to how this would be done.

Seção Judiciária do Distrito Federal). The Tribunal rejected to suspend application of Resolution No 493.

**Table 1. Chronicle of events**

<b>AUGUST 2001</b>	ANEEL publishes Technical Note No. 097/2001 reporting provisional use of replacement cost asset valuation methodology for ESCELSA tariff review.
<b>JUNE 2002</b>	ANEEL publishes Technical Note No. 148/2002 discussing asset valuation options and identifying DORC as preferred methodology.
<b>JUNE TO JULY 2002</b>	ANEEL convenes Public Audience No. 005/2002 to consult on asset valuation methodology.
<b>SEPTEMBER 2002</b>	ANEEL issues Resolution No. 493/2002 adopting the DORC methodology
<b>OCTOBER TO DECEMBER 2002</b>	ABRADEE appeals in the first instance to ANEEL and in a second instance to the Courts against ANEEL's choice of the DORC methodology, asking for immediate suspension of its application and demanding the use of the minimum sale price as a basis for asset valuation (Ação Ordinária nº 2002.34.00.039564-0/DF, 3ª Vara Federal da Seção Judiciária do Distrito Federal). The Tribunal rejected to suspend application of Resolution No 493.
<b>FEBRUARY TO JULY 2003</b>	ANEEL publishes Technical Notes Nos. 40-43, 48-52, 97, 119, 127/2003 reporting provisional asset valuations used in 12 tariff determinations for each company based on replacement cost adjusted to a cap based on the Reference Utility.
<b>AUGUST 2003</b>	ANEEL publishes Technical Note No. 178/2003 providing further clarification and guidelines for the application of the DORC methodology.
<b>FEBRUARY TO JULY 2004</b>	By these dates, ANEEL promises to hold another Public Audience on the use of comparative efficiency adjustments in asset valuation, and to publish definitive tariff determinations.

Initially, it appeared as though this entire process would need to be repeated every four to five years ahead of each successive tariff review, due to the restrictions on indexation of asset values under Brazilian tax law. However, in the final version of the methodology for Asset Valuation described in the Resolution N° 493/2002, ANEEL modified that approach by allowing DORC to be rolled forward through the addition of net new investments at the end of each tariff period as well as adjustments to reflect movements in the market prices of assets (without necessarily reflecting the full extent of general price inflation in the intervening period).

By February 2003, the first set of companies had presented their proposed asset valuations based on the DORC approach. The implementation of the methodology proved to be more complex than anticipated, such that ANEEL found several inconsistencies in the data submitted. In response, ANEEL ran a series of training workshops for the accounting firms involved in the asset valuation process, and in August 2003 published a new Technical Note No. 178/2003 providing around 50 pages of more extensive guidelines on how to apply the methodology.

However, in the meantime, ANEEL was legally obliged to publish tariff determinations for the first batch of 12 distribution concessionaires between February and July 2003. Having concluded that the DORC estimates were not yet sufficiently reliable to be used for tariff setting purposes, the Agency decided to base the reviews on a provisional estimate of the regulatory asset base. In common with the ESCELSA review, the provisional asset value was based on the replacement cost of the assets. However, in contrast to the ESCELSA case, ANEEL used the Reference Utility approach to establish a cap on the level of gross replacement cost that would be considered in the tariff determination, basing itself on the benchmarking provisions laid down in Article 10 of Resolution No. 493/2002. Operationally, this was possible because ANEEL had already developed Reference Utilities to evaluate the efficiency of operating expenditure, which provided a basis for estimating the regulatory asset base. As a result of these adjustments, different companies received between 65%-90% of their respective replacement cost.

In the Technical Notes that lay out the tariff determinations (Nos. 040-043,048-052, 097,119,127/2003), ANEEL underlines the relevance of the Reference Utility approach to the asset valuation problem, arguing that it represents the closest approximation to the costs that would be faced by an efficient new entrant to the market. The Agency also promises to hold a Public Audience in order to finally settle upon the methodology to be used to make efficiency comparisons between companies in accordance with Article 10 of Resolution No. 493/2002, and commits itself to providing the definitive tariff determination within a 12 month period.

In this context it is interesting to notice that the results of calculations performed for 17 companies show that in all the cases the divergence between the GORC and the gross replacement cost of existing assets is no more than 20%. This result suggests that the configuration of electricity distribution networks for these companies has tended to follow sound technical procedures over time, and may therefore make it easier to reach a consensus between company demands that the RAB consider the historic accumulation of assets in each company and regulatory concerns that the RAB should not pass on the cost of inefficient investment decisions to electricity consumers.

### **Key lessons learned**

Although as yet unconcluded, the story of the Brazilian electricity distribution reviews provides a fascinating illustration of the complexities and controversies that often surround regulatory decisions about asset valuation. A number of key lessons can be drawn with wider relevance.

- The choice of asset valuation methodology must necessarily be guided by the specific details of each regulatory context; there is no single approach that is correct in every case. In making this choice, it is particularly important to consider the method of privatization used, the quality of available accounting information and the legal framework.
- Asset valuation presents a strong trade-off between simplicity and accuracy. In countries with a weak accounting history, it may be necessary to opt for simpler approaches at least in the short term.

- The distance between theory and practice can be quite considerable. It is therefore advisable to put theoretically attractive methodologies to the empirical test, before espousing them as regulatory policy.
  - It is extremely important to provide, at least broad methodological guidance, on asset valuation in the original regulatory framework at the time of privatization. Doing so, can avoid substantial problems and conflicts at the first regulatory review, and ensures that investors do not form inappropriate expectations. Even when this is done, there will still be significant methodological issues to be worked out at the first regulatory review. As a result, it is important to initiate this process well in advance of the review, and to provide for adequate consultation channels with all stakeholders, as is well illustrated by the use of Public Audiences and Technical Notes in the Brazilian case.
  - The annuity value (sinking fund factor) that arises from the GORC methodology provides a conceptual ceiling on what customers should pay towards capital costs. The reason is that this value represents the amount that a new entrant in a competitive market would require to sustain its assets in the long run.
  - The choice of accounting lives for depreciation of regulatory assets raises issues of inter-generational equity. To the extent that accounting lives are shorter than economic lives, where accelerated depreciation schedules are used, the burden of asset replacement will fall disproportionately on current customers.
  - The process of regulation often presents different accounting needs to the process of corporate taxation, and as a consequence it may be necessary to use separate accounting norms for each of these purposes.
- Once a baseline asset valuation has been established at the first review, it is extremely important to maintain this policy over time, making it preferable to establish a simple and predictable rule for rolling it forward to future reviews; for example, by adjusting for inflation and net new investment. This has the advantage of reducing the administrative costs of the process, and (most importantly) creating a stable and predictable rule for asset valuation. Large jumps in regulatory asset values should be avoided, and if absolutely essential, should be phased in gradually so as to avoid corresponding jumps in tariffs and basic financial indicators.

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### Working Notes

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