

STUDY

ASSESSMENT OF COSTS AND BENEFITS OF ELECTRICITY PRODUCTION FROM RENEWABLE ENERGY SOURCES

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International Partners



Who we are

The Portuguese Renewable Energy Association (APREN) is a nonprofit association, created in October 1988 with the mission to coordinate, represent and defend the common interests of its Associates.

APREN's Associates are companies holding renewable electricity production licenses under the special regime (PRE-FER), as well as any persons, individual or collective, interested in the development of renewable energies in Portugal. At the end of 2010 APREN represented approximately 85% of PRE-FER installed power in Portugal.

APREN develops its work together with official authorities and other associations, at national and international level, acting as an instrument for participation in the draft of Portuguese energy policies, and promoting the use and the value of national renewable energy resources for electricity production.

23 years defending renewable energy



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EXECUTIVE SUMMARY OF THE STUDY

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INTRODUCTION

Portugal's energy policy options in terms of electricity production from renewable sources have been largely discussed over the past decade, though not effectively enough to clarify its effective costs and benefits. On the other hand, the current electricity tariff structure is quite complex and although it has been widely debated in the media, most of the times such discussion lacked the accuracy and detail that would be recommendable.

In the light of the above, APREN turned to Roland Berger Strategy Consultants – a company with large experience in the sector, both at national and international levels, to make a thorough, independent study based on solid economic models capable of projecting the sector's evolution in the long term and reflecting the needs and perception of electricity consumers as well as the situation in other international energy markets.

In methodological terms, public information sources, from recognized institutions were used in order to ensure exemption and solidity to the analyses carried out for the study. For the same reason, the energy policy assumptions and respective supporting mechanisms considered were the ones in force as of June 2011 and were maintained throughout the period under review. The study used the most conservative assumptions possible in terms of benefits of renewable energy sources.

Likewise, in order to avoid presenting conclusions based on one year only and because the study deals with a sector where invest-

ments are made within a long term horizon, the analyses presented are based, whenever possible, on series of data. For the analysis of the past, it was opted for the 2005-2010 period, whilst in terms of future outlook, the time spectrum considered was 20 years, i.e. 2011 to 2030.

International benchmarking included four of the most relevant European countries in terms of energy policy, namely Spain, Germany, Italy and France.

Additionally, four Focus Groups' sessions were carried out to assess consumer perception and awareness to the issues under analysis. Each session had a 30 minutes duration, involved 8 participants, male and female, aged 30 to 65, and was supported by slideshows. Two sessions took place both in Lisbon and Oporto with participants from two different professional backgrounds.

In general terms, the study seeks to evaluate the option of electricity production from renewable sources under special regime (PRE-FER) and respective support scheme, by analyzing the past decade and showing the implications of its long term development.

Finally, it should be noted that the conclusions of this study should be seen as an objective contribution to the analysis of the costs and benefits of PRE-FER. However, to completely assess electricity production from renewable sources, other aspects not quantified in this study should be considered, namely at economic, environmental and regional development levels.

NOTE: IT WAS CHOSEN TO KEEP THE PORTUGUESE VERSION OF ALL THE ACRONYMS REFERRED THROUGHOUT THE STUDY.



ANALYSIS OF THE PAST

The balance of having decided for the production of electricity from renewable sources under special regime [PRE-FER] in Portugal during the 2005–2010 period is globally favorable, resulting from the focus on more mature technologies, namely wind energy, which accounted for 84% of PRE-FER power installed up to 2010 and an average load factor (or productivity) of 25%, standing above of the countries included in the international benchmark.

PRE-FER feed-in tariffs (FIT) in Portugal are competitive when compared to the European countries analyzed in this study, namely Spain, Germany, Italy and France. In 2010, the average value of PRE-FER tariffs in Portugal stood 15% below the average of these European countries and the current FIT applied to wind energy projects installed as from 2009 (€ 70/MWh) was also the lowest.

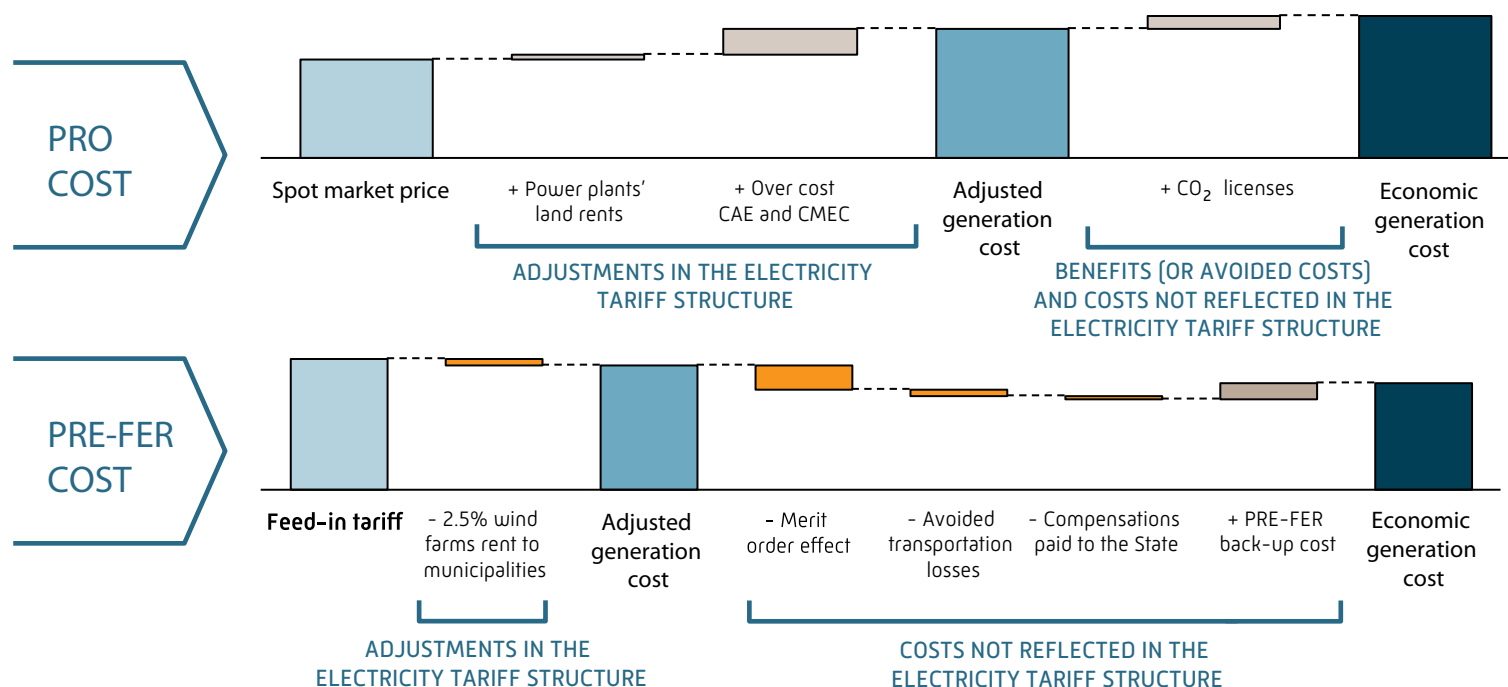
From 1990 to 2010 electricity prices in Portugal decreased to below European Union average, which confirms the positive balance of the domestic energy policy followed in the last decade.

The Focus Groups' conclusions revealed that the Portuguese consumer is favorable to and supports the country's investment in renewable energies, holding great pride in this policy and is ready to pay an additional cost of € 2/month to finance these energy sources, provided such financing is made in a clear and transparent way.

It also became clear that part of the existing confusion about PRE-FER costs results from the fact that their comparison with the cost of Ordinary Regime Production (PRO) is misadjusted as it compares the final cost of PRE-FER with the average spot market price, and this price does not reflect all PRO costs.

Therefore, the methodology for comparing costs must be altered, evolving from the present financial view to an economic view of generation costs adjusted to internalize all costs and benefits relating to both types of power generation.

ADJUSTMENTS TO ELECTRICITY GENERATION COST – METHODOLOGY APPLIED FROM 2005 TO 2010

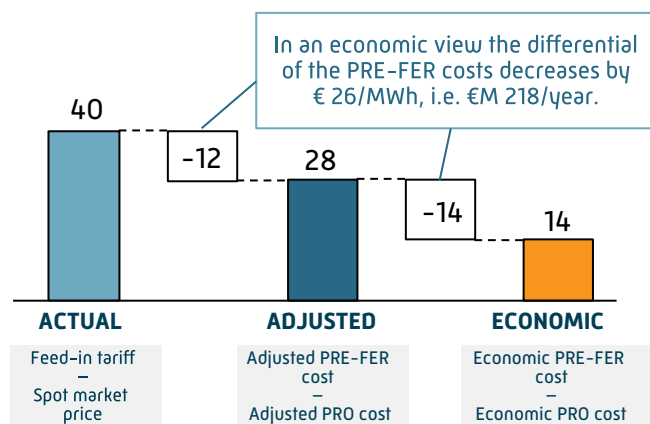


The adjustments proposed at PRO level for the 2005-2010 period concern the integration of amounts received (or costs not considered) from producers in ordinary regime which are not reflected in spot market prices. These adjustments include the cost of power plants' land rents, CO₂ licenses and the over cost relating to PRO power purchase agreements in force, called CAE (Energy Acquisition Contracts) and CMEC (Contractual Equilibrium Maintenance Contracts), which establish a guaranteed remuneration for PRO.

In what concerns the PRE-FER, the adjustments considered deducting from total costs the extra costs or benefits of the PRE-

FER not accounted for in the FIT, namely: mandatory payment of 2.5% of gross income from wind farms to municipalities (amount which no other form of electricity production pays); the merit order effect, resulting from lowering market price due to the shift in the electricity supply curve following the entrance of PRE-FER electricity; avoided losses in the transport grid; and compensations paid to the State in the last tenders for power allocation, revenues that were withdrawn from the electric system. The back-up cost was also added, i.e. the cost of reserve power to face possible fluctuations in PRE-FER production.

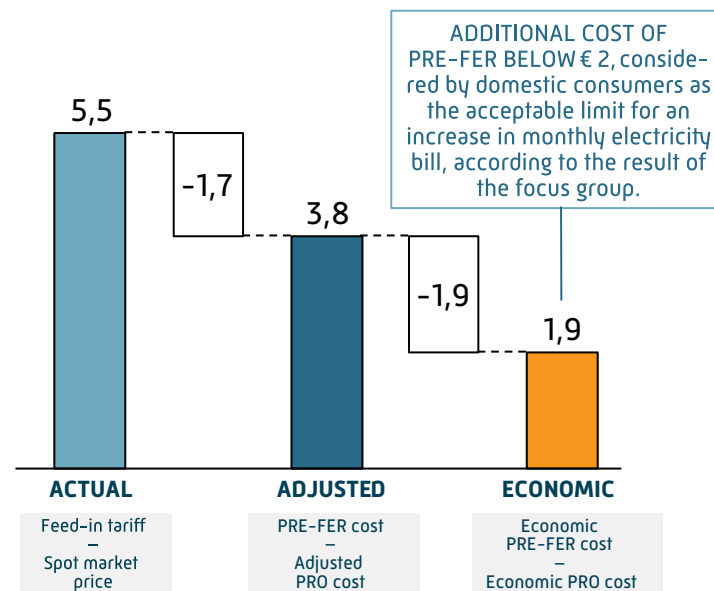
AVERAGE UNITARY COST DIFFERENTIAL [€/MWh]



Average annual cost differential [€/year]



AVERAGE MONTHLY ELECTRICITY BILL DIFFERENTIAL [€/month]

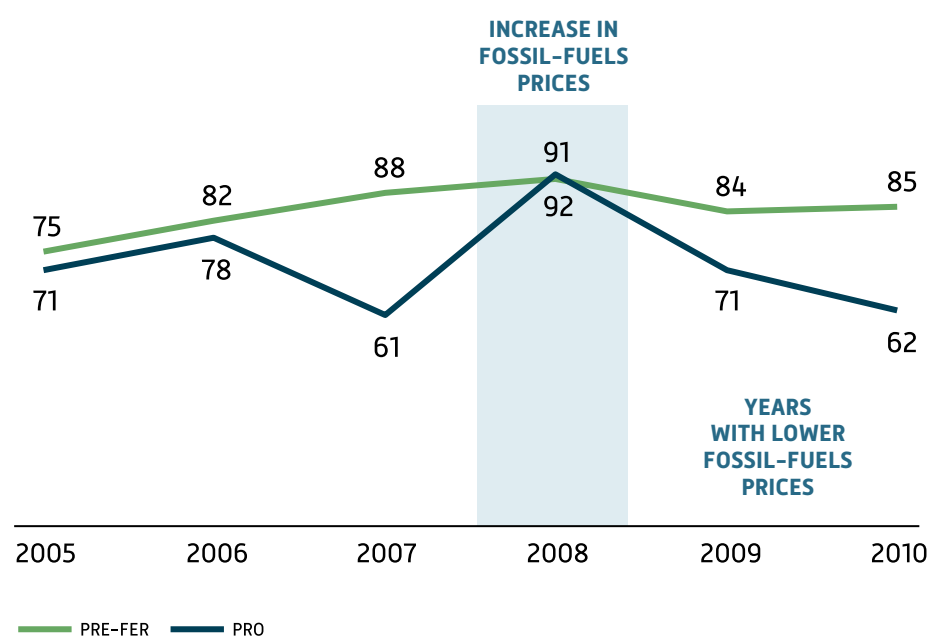


Applying the adjusted economic view, the cost differential of PRE-FER as against PRO falls from € 40/MWh to € 14/MWh, or, from another perspective, it falls from a total annual average cost of €M 329 to €M 111. The impact on the average domestic consumer monthly bill is of € 1.9, which is lower than the € 2/month rise accepted by domestic consumers to promote renewable energies.

The analysis from an economic point of view of PRE-FER and PRO generation costs reveals that in 2008, PRE-FER posted benefits in relation to PRO, due to the rise in fossil-fuels prices. These benefits reversed in the following years due to the decoupling of natural gas and oil prices and corresponding decrease in natural gas pri-

ces; however, the foreseeable trend points towards greater competitiveness of PRE-FER with the increase in fossil-fuels prices. It should also be noted that the average cost of PRE-FER is more stable throughout the years, showing its absorbing effect against market volatility.

EVOLUTION OF THE ECONOMIC UNITARY GENERATION COST - PRE-FER VS PRO [€/MWh]



Furthermore, the development of PRE-FER has benefits in terms of avoided costs with the importing of fossil-fuels (natural gas and coal) and CO₂, which is translated in approximately €M 2,450 in the 2005-2010 period (€M 400/year). Adding to these benefits, there are other positive external factors, such as contribution to job creation, security of supply and diversification of primary energy sources.

Finally, it should be pointed out that under the terms of Decree-Law 90/2006, the cost difference between PRE and PRO's reference value is allocated according to voltage level, and proportional to the number of consumers connected to each voltage level. As result, this difference is mainly supported by Normal Low Voltage consumers, i.e. households and small industrial and commercial consumers.

FUTURE OUTLOOK

The study considered three different scenarios of PRE-FER contribution for the 2011-2030 period, depending on the year of execution of the Iberian NREAP (National Renewable Energy Action Plans): Scenario A, with lower penetration of renewable energy, estimates a delay of ten years in the implementation of both NREAP (completion in 2030); scenario B, estimates a delay of five years (completion in 2025); and scenario C, with larger renewables penetration, corresponds to the completion of both NREAP in 2020, as foreseen in the documents provided to the European Commission.

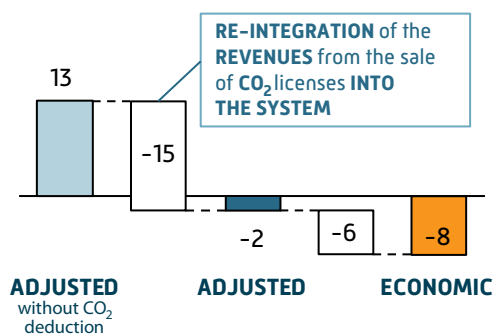
In line with what was done for the analysis of the past period, the evaluation of the cost differential between PRE-FER and PRO genera-

tion requires a number of adjustments in the 2011-2030 period. All adjustments described for the 2005-2010 period are maintained, except for the revenues resulting from the sale of CO₂ licenses of electricity production, which are reintegrated in the system as an amount to deduct to PRE-FER, under the terms provided in Directive 2009/29/CE of EU-ETS (EU Emissions Trading Scheme).

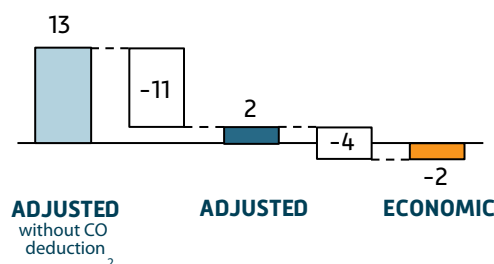
From an economic perspective, in scenarios A and B, PRE-FER shows an economic cost lower than PRO by € 8 to € 2/MWh, equivalent to a total annual average benefit of €M 104 to €M 24. In scenario C, there is an additional economic cost of € 3/MWh, or €M 73/year.

DIFFERENTIAL OF UNITARY GENERATION COST PRE-FER VS PRO [€/MWh]

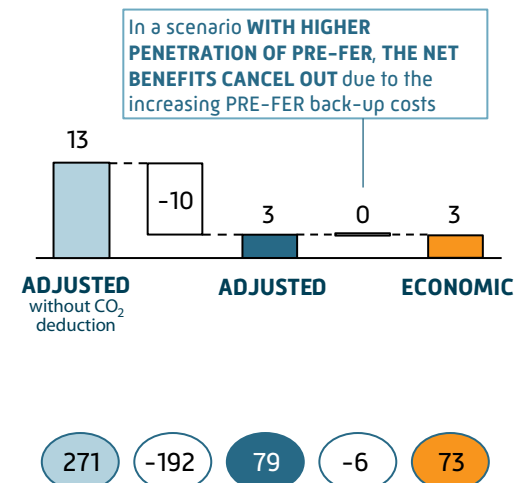
A 100% IN 2030



B 100% IN 2025



C 100% IN 2020

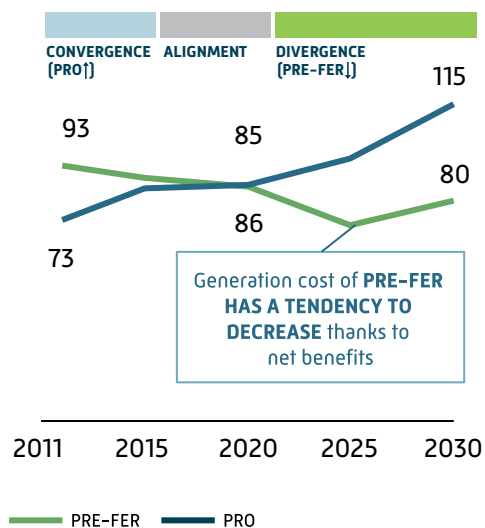


In general terms, for any of the scenarios under review, PRE-FER will be more competitive than PRO as from 2020. In scenarios with lower renewable penetration, we see a convergence period up to 2015 and a cost inversion between 2015 and 2020, when PRE-FER will become cheaper than PRO. From 2020 onwards, PRE-FER distances itself clearly from PRO which continues to rise. The difference between PRE-FER and PRO is not so clear in scenario C and costs of both forms of generation remain aligned until 2030.

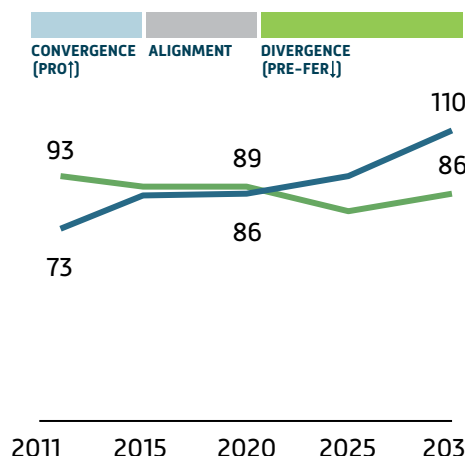
Cost evolution results from the combination of various factors. A larger penetration of PRE-FER leads simultaneously to a decrease in the cost of PRO, resulting from the merit order effect, and to an increase in PRE cost, deriving from the larger weight of technologies with higher tariffs and an increase in back-up costs.

EVOLUTION OF THE ECONOMIC VIEW OF THE UNITARY GENERATION COST – PRE-FER VS PRO [€/MWh]

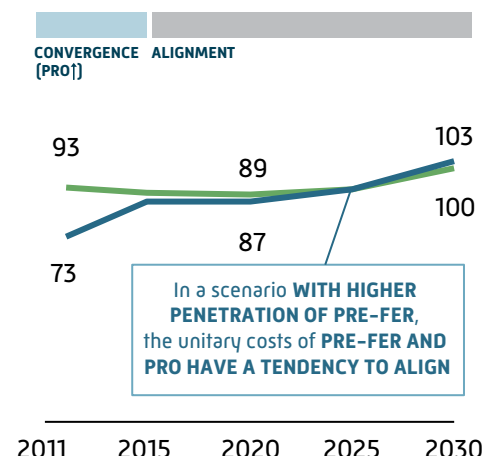
A 100% IN 2030



B 100% IN 2025

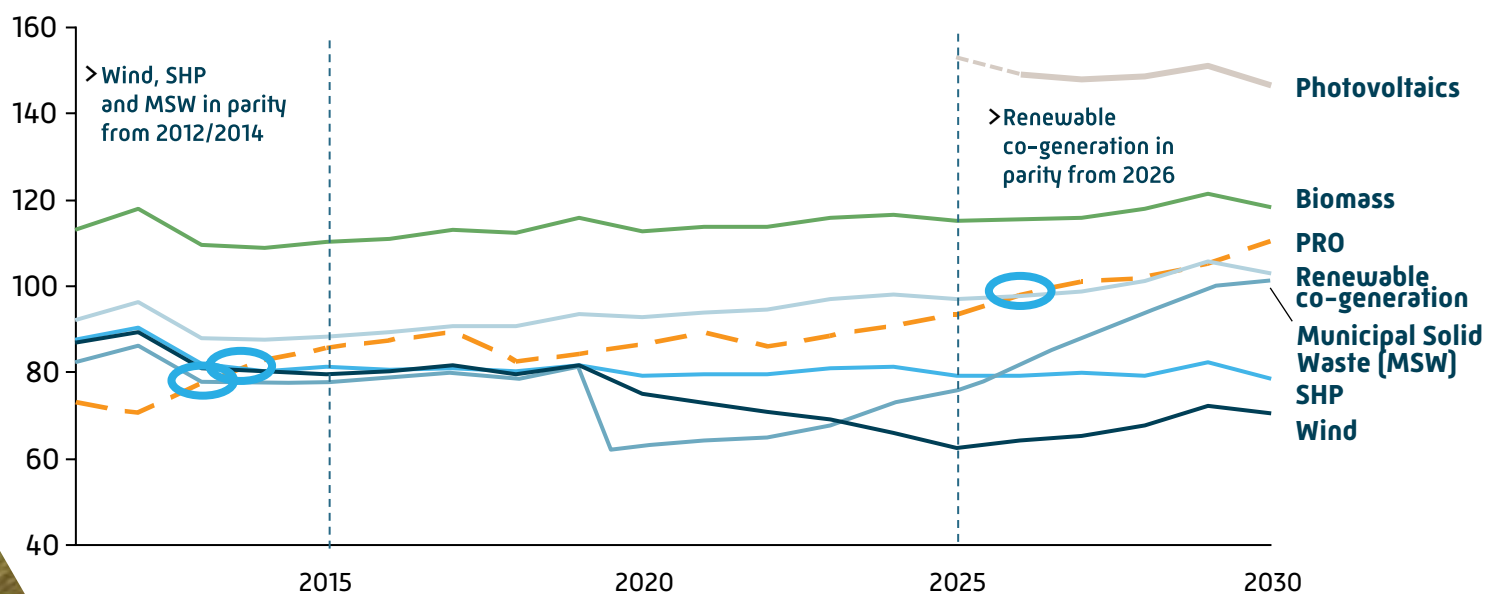


C 100% IN 2020



The results of the scenarios under review are influenced by the mix of renewable energy sources considered, which bears in mind the difference in maturity and costs of the different technologies. The cost of wind power generation and Small Hydro Power Plants (SHP) generation will be lower than PRO's as from 2014 for any of the scenarios reviewed, corresponding to average annual savings of € 20/MWh to € 12/MWh in the wind power case and € 14/MWh and € 4/MWh in the SHPs case. Conversely, photovoltaic solar energy and biomass have a higher cost as compared to PRO, regardless of the scenario considered.

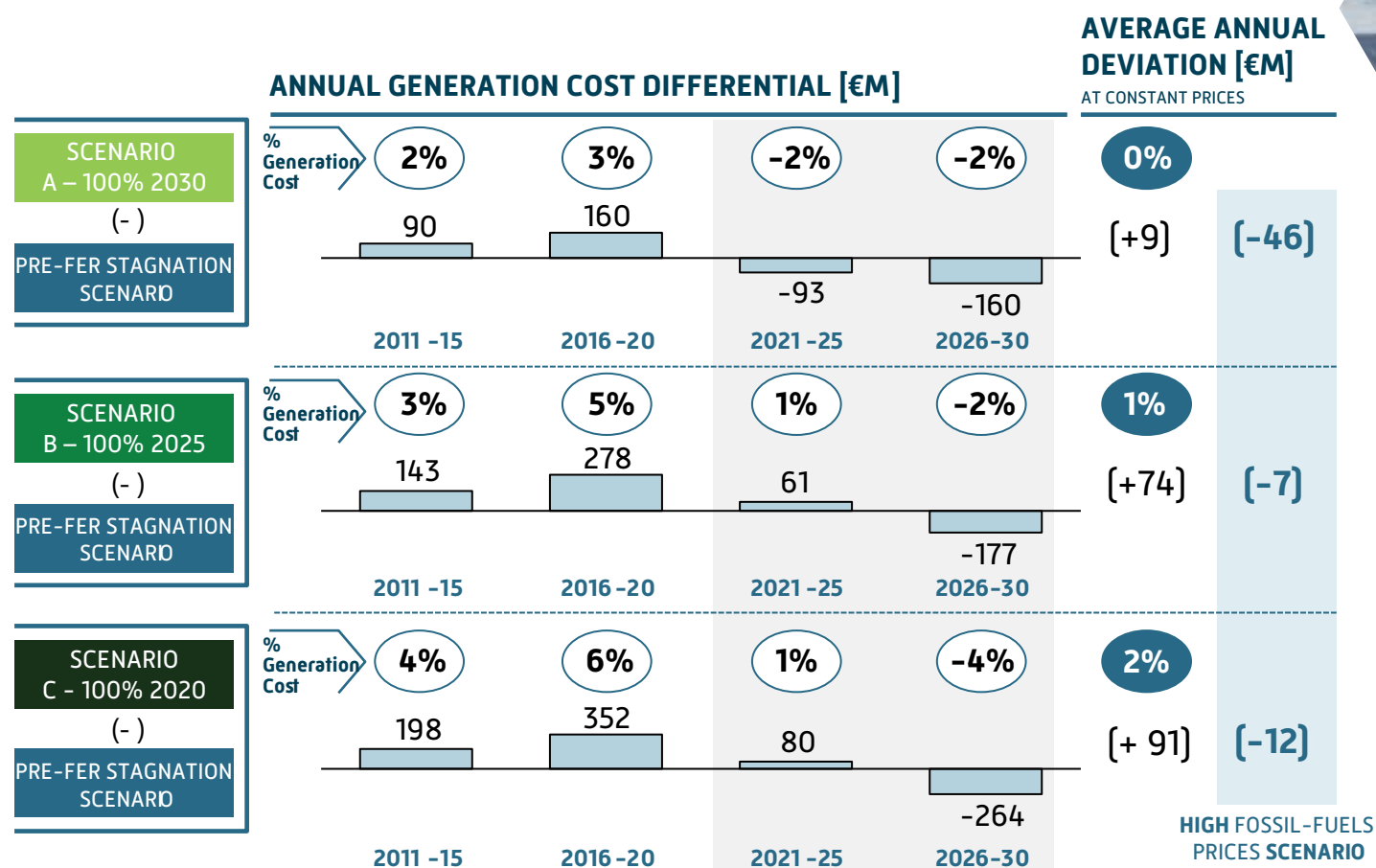
EVOLUTION OF THE ECONOMIC UNITARY GENERATION COST BY RENEWABLE SOURCE – SCENARIO B [€/MWh]



The outlook must also take into account the costs avoided by PRE-FER in terms of savings in imports of fossil-fuels and purchase of CO₂ licenses. These benefits are increasingly significant, reaching approximately €M 32,000 in 2011-2030 in cumulative terms, i.e. an average of €M 1,500 per year, in scenario B.

To assess the sensitivity of the results obtained to certain changes in assumptions, two alternative scenarios were drawn up: stagnation of PRE-FER and larger increase in fossil-fuels prices.

In the short term, no advantage is foreseen in a scenario of PRE-FER stagnation against scenarios with larger penetration of renewable electricity, since the stagnation scenario shows savings in terms of total generation cost of less than 2%, but involves the loss of all benefits associated to the sector's development. Moreover, from 2025 onwards, all scenarios analysed show lower annual costs as compared to a stagnation scenario. In a scenario of an increase in fossil-fuels prices, all scenarios show a consolidated annual average generation costs below the stagnation scenario costs.



TARIFF POLICY SUGGESTIONS

This study strengthens the need for increased transparency in the presentation of the different items that make up the electricity tariff, in line with what was already presented in a petition by DECO (Portuguese Consumer's Defense Association) started in November 2010, submitted to Parliament in March 2011 and mentioned in the New Tariff Regulation published in August 2011. This will require the using of methodologies providing a fair and direct analysis of the different costs of electricity generation.

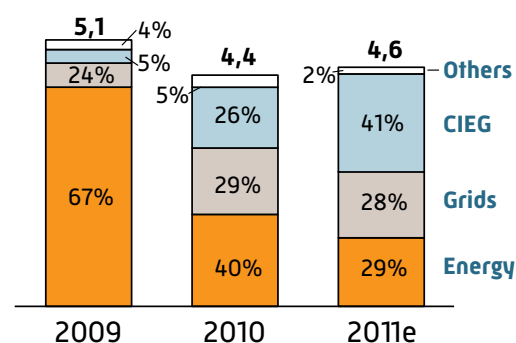
First of all, adjustments to the methodology for calculating the cost differential between PRE-FER and PRO must be made viewing an adjusted analysis of generation costs that includes the costs and benefits of the two types of electricity generation.

The current tariff structure has a distorted view of energy costs, as it does not reflect all the costs of PRO, namely costs with CAE and CMEC, which are contractualized generation costs of the PRO. These costs should be withdrawn from the tariff item General Economic Interest's Costs (CIEG) and should be included in Energy Costs, thus limiting the increase experienced in these so called "energy policy costs" that have no correspondence with the evolution of PRE-FER. Following the adjustment in the cost of energy, the weight of CIEG on the tariff falls from 41% to 15% in the structure estimated for 2011.

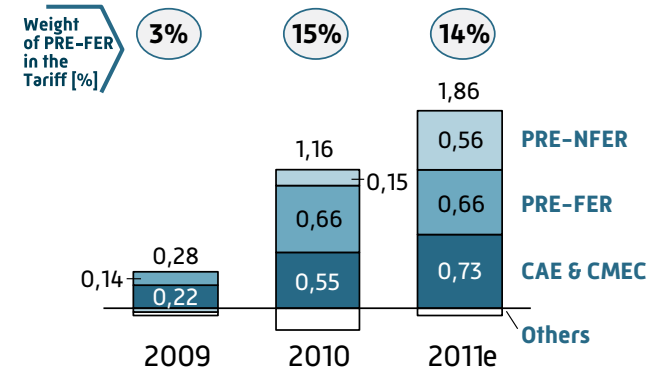
On the other hand, the PRE-FER differential is over estimated. The re-integration in the system of revenues from the sale of CO₂ licenses as cost to deduct to PRE-FER is also a relevant issue, and is even considered in the EU-ETS Directive. In the adjusted view, which reflects the differential between PRO and PRE-FER adjusted generation unitary costs according to the methodology proposed in this study, the weight of PRE-FER differential in the tariff decreases from 14% to 8%.

ELECTRICITY TARIFF STRUCTURE – ACTUAL VISION [€bn]

STRUCTURE OF ALLOWED REVENUES

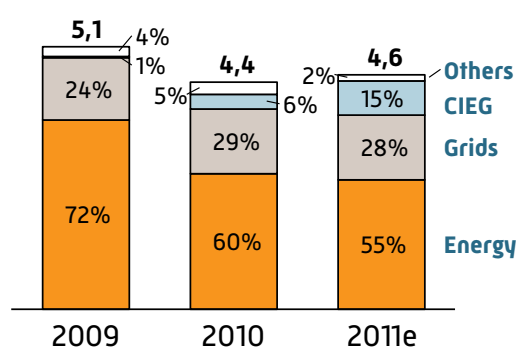


STRUCTURE OF GENERAL ECONOMIC INTEREST'S COSTS (CIEG)

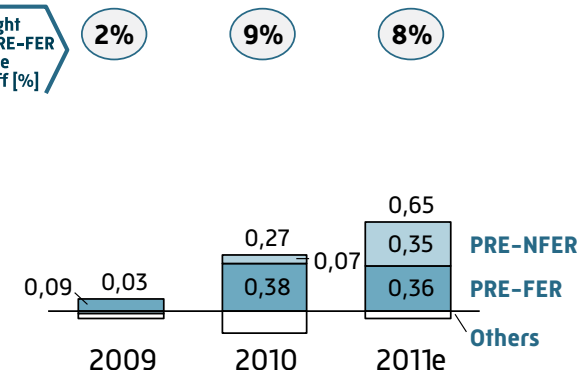


ELECTRICITY TARIFF STRUCTURE – ADJUSTED VISION [€bn]

STRUCTURE OF ALLOWED REVENUES



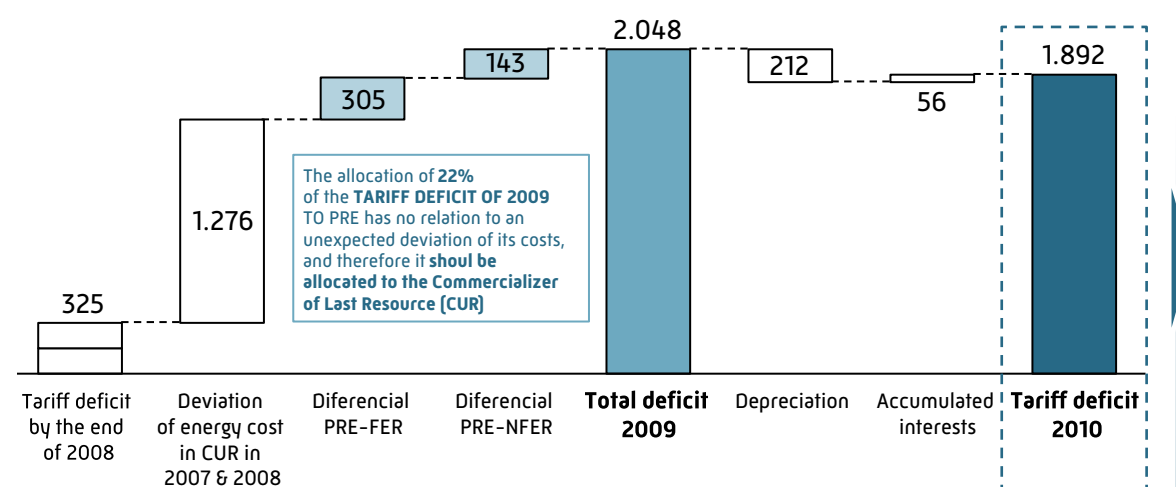
STRUCTURE OF GENERAL ECONOMIC INTEREST'S COSTS (CIEG)



Along with changes in the methodology to determine the differential, the information on tariffs should be presented more clearly in order to prevent reading distortions. The amount of the PRE differential should separate the renewable component; PRE-FER, from the non renewable component; PRE-NFER (fossil co-generation). Besides, this differential should be individualized from the CIEG since it is sufficiently important, thus avoiding incorrect associations. We also suggest the replacement of the term “over cost” by “cost differential”, since it may be positive or negative.

The origin of the tariff deficit should also be more detailed so that it remains clear that it does not derive from a deviation in the predicted cost of PRE-FER, but from an increase above the estimates in fossil-fuels prices. Moreover, in 2010, only 15% of the tariff deficit is allocated to PRE-FER and this amount does not stem from an unexpected deviation in this type of generation, but from a one-off decision of not including in the tariffs the differential of PRE in 2009, conversely to common practice. This cost should thus be allocated to the energy cost of the Commercializer of Last Resource (CUR) instead of to PRE.

DETAIL OF THE PORTUGUESE TARIFF DEFICIT – STRUCTURE PRESENTED BY THE ENERGY REGULATOR [M€]



> **THE TARIFF DEFICIT ALLOCATED TO PRE IN 2009 (22%)** is due to a political decision of not including in the tariffs the differential of PRE in 2009, in opposition of what was done in previous years

> **THE AMORTIZATION PLAN OF THE DEFICIT IS ALREADY INCLUDED IN THE TARIFFS** – it will not contribute to future tariff increases

NOT INCLUDED IN 2009 ELECTRICITY TARIFFS
[DL 165/2008 application]

FINAL REMARKS

- **The current incentive scheme to PRE-FER is competitive**, as compared to other European countries, and the technology with larger weight in the PRE-FER mix, i.e. wind generation, has the lowest feed-in tariff amongst the countries under review.
- **The methodology for comparing the cost differences between PRE-FER and PRO is ill-adjusted**, and should be adjusted to “internalize” costs and benefits relating to both types of generation, evolving from the present financial view towards an economic view.
- From 2005 to 2010, changing to an economic view translates into an average **decrease of € 26/MWh in the cost differential of PRE-FER** as compared to PRO, i.e. a decrease by 65% in the amount normally reported.
- **From an economic point of view, the PRE-FER stands out**, particularly in a medium/long term analysis:
 - In the 2005-2010 period, the average **cost differential of the PRE-FER as against the PRO is of €M 111/year**. PRE-FER’s benefits in terms of fossil-fuels imports and purchase of CO₂ licenses account **for average savings of €M 407/year**.
 - In what concerns the 2011-2030 period, in scenario B, **the average cost differential of the PRE-FER as against the PRO corresponds to average savings of €M 24/year**. Additionally, PRE-FER’s advantages in terms of fossil-fuels imports and purchase of CO₂ licenses for the said scenario **account for average savings of €M 1,240/year**.
- **From 2020 onwards, for any of the scenarios under review, PRE-FER shows an economic unitary cost below PRO’s**. More mature technologies, such as wind generation and SHP, should present already in 2014 an economic cost below PRO’s. Less mature technologies, such as solar, or those with higher related costs, such as biomass, continue to hold a unitary cost above PRO’s in the period under analysis.
- **It is evident that a scenario of stagnation of the PRE-FER will harm the development of the electric sector in Portugal**, as savings in terms of total generation costs only vary by 0% to 2% according to the scenario, but all related advantages will be lost. Against a background of higher fossil-fuels prices, any of the scenarios under review will translate into total generation costs lower than those of a stagnation scenario.
- **The tariff structure should suffer some adjustments** in order to increase the transparency in the communication of PRE-FER costs and change the methodology to determine the differential of PRE-FER as against PRO which presently does not reflect the reality. **The integration of CAE and CMEC in PRO costs and the re-integration of the value of CO₂ licenses into the system, as amount to deduct to PRE-FER cost**, are two issues that should be acted upon in the short term.
- **Renewable energies have other advantages that were not taken into account in this study, but should not be ignored**, namely: job creation; internationalization of national companies and attraction of foreign investment; exporting of equipment and services; increase in the security of supply; decrease in national energy dependence on external sources; decrease in environmental damages associated to the production of electricity and; regional development. A former study promoted by APREN carried out in 2008 **foresaw that by 2015, the renewable energy sector would contribute with €M 4,120 to the National GDP and would generate 60,800 jobs**.
- The importance of the electric sector on the economy and the Portuguese consumer awareness to the country’s economic situation requires the joint effort of **the different stakeholders in the sector to contribute to a better clarification of the real costs and benefits of the various power generation technologies**.





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Renewable Energy Guarantees the Future

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Energias Renováveis

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Strategy Consultants