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The Governance of Maintenance and Investment in Infrastructures

Conference report

Conference organised by the Club of Regulators in cooperation with the OECD Network of Economic Regulators

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CLUB

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The Governance of Maintenance and Investment in Infrastructures

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Infrastructure maintenance and investment are key regulatory and policy concerns and are central to optimising the long-term quality of essential services. Still, when setting the structure and level of charges, as well as the performance objectives, regulators only have limited information on the conditions and cost drivers of the assets managed by the operators they regulate. Moreover, the relevant constraints and requirements for capital expenditure may not necessarily be aligned with regulatory periods. This report focuses on the complex issues raised by the governance of the relationship between the operators, the economic regulator and public authorities, and shares insights from different industries and countries to highlight best practices and explore responses to challenges.

1st roundtable : Infrastructure Maintenance

Regulating infrastructure network managers

Bryan Adey
Professor, ETH Zürich

In an ideal world, network regulators would set performance objectives based on the services that network managers provide, and network managers would be incentivized to provide these services. Achieving this outcome requires the ability to estimate the condition of infrastructure over time, allocate the right amount of money for infrastructure, connect performance objectives to asset performance, determine the role of information, establish the relationship between cost drivers and performance reviews, and use new technologies to assess the condition and performance of assets.

Infrastructure regulators and managers must have a complete description of the whole of the infrastructure at the right level of abstraction. The description must cover all potential states and be complete and based on reasonable estimates. Responsibilities and values must be clearly defined and both parties must know what is important, how it will be measured and evaluated, and how it can reasonably be expected to evolve in the future. All possible infrastructure states and interventions must be described; the likelihood that these states will arise, the costs of the changes involved, and the impact that this could have on stakeholders, for example in terms of cost and traffic disruption, must be estimated. The probability of failure must be calculated for each possible state and intervention, as well as the probability of accidents, injuries and fatalities. Finally, the model must include the different repair and replacement strategies that could be appropriate for each asset in each state.

With a complete model, it is possible to simulate the effect of different management strategies and investments on service delivery and assess their costs and risks for stakeholders. Financing decisions and performance objectives can then focus on assets where there is high uncertainty, high risk or high potential.

New technologies can be used to evaluate states and changes, reliability and availability, and proxies and risks. They make it possible to estimate strategies and expected costs and evaluate network management performance. Evaluations must be focused on the service that network managers are providing over a given time period and structured so as to incentivise them to deliver the desired outcome.

EU project DESTinationRAIL

Michael Robson
Managing Director, International Rail Transport Consultancy

Infrastructure managers require clarity about what they are expected to deliver and when, consistent rules that enable them work effectively across boundaries, sufficient capacity at network nodes, and access to information about the quality, safety and cost of their assets. Funding must take account of multi-year lifecycle costs and maintenance should be evaluated relative to the condition of the asset rather than a set of prescriptive standards. A one-off solution tends to be more cost effective than repeated small repairs.

The DESTinationRail project is designed to reduce infrastructure costs and deliver practical solutions. Through data analysis and collation, it is identifying and quantifying risks and developing a decision support tool that will enable infrastructure managers to make rational investment choices. Technologies like ground penetrating radar, sensors and drones offer a cost-effective, practical solution to many of the complex monitoring and assessment tasks required for the safe operation and maintenance of rail assets as diverse as bridges, switches, embankments and tracks.

The installation of monitoring equipment should be obligatory during new projects and major renewals. Infrastructure managers should share their data with regulators to facilitate cooperation. Changes in traffic flows, rolling stock and environmental conditions can and do affect network conditions; climate change in particular is likely to cause increasing numbers of costly, catastrophic failures of cuttings and embankments in the coming years. Infrastructure managers would be well advised to invest in conducting high quality surveys of embankments to mitigate these risks.

The economic regulation of the Channel Tunnel

Brian Kogan
Deputy Director, Strategy and Policy - Office of Rail and Road

The Office of Road and Rail (ORR) is the economic and safety regulator of Network Rail and the HS1 high-speed link between London and the Channel Tunnel. It has a number of powers to compel change and take enforcement action. National Rail manages 32,000 km of track plus thousands of other assets. It was privatised in the mid-1990s, restructured as a hybrid company following a crisis in its maintenance programme in 2003, and brought fully back under state control in 2014. About 70% of its income comes from the government and 25% from access charges paid by train operators. HS1 has 108 km of track and four stations. Two pension funds hold the 30-year operating concession following a competitive bidding process held in 2010. To minimise the risk of conflicts of interest and accounting complexities, neither operator is allowed to operate trains.

There is a critical relationship between rail safety and asset management and maintenance. ORR conducts reviews of charges every five years. The ORR relies on high levels of transparency, consultation and participation from all parties to ensure an effective process, optimise stakeholder involvement and enhance ownership of the decisions. The government is closely involved in the process for Network Rail. The review process takes three years, with circumstances, policies, demand and funding availability tending to change during this time. Fortunately, good planning can cover most eventualities. The charges review for HS1 is smaller and is governed by the concession agreement rather than a statutory process. The operator is responsible for delivering the operation, maintenance and renewal of the network in a timely, efficient and economical manner over a 40-year period. The consultation process takes around 30 months.

A reduction in stakeholder involvement and transparency would speed up the review processes. However, regulators have a duty to ensure that funding, both private and public, is efficiently used and transparency is a powerful tool in this process. Predictable regulation and open, honest communication are critical to the value of the asset and the operator's ability to continue in operation.

The maintenance of the French rail infrastructure

Jean-François Ducoing
Directeur de la régulation, SNCF Réseau

SNCF Réseau maintains 50,000 km of tracks, performing day-to-day operations such as surveys and small track repairs as well as renewals. The network has been under-maintained since the early 1980s, when political attention shifted to developing the vote-winning high-speed rail network and the State became reluctant to allocate funding to SNCF Réseau's predecessors probably due to concerns about insufficient productivity.

External Audits in 2005 and 2012 highlighted the need for better maintenance of tracks, signalling and electric systems and steps have been taken to address the problems. Nevertheless, thirty years of underinvestment in maintenance has disrupted the normal cycle across the network and additional work is required to remedy the situation. This creates financial and industrial challenges: SNCF Réseau does not have sufficient funds to close the gap and extra renewals have a huge impact on the quality of service (notably paths allocation for freights transports). To overcome the problems, three priorities have been identified for 2030: renovating key parts of the network, increasing capacity in nodes and key axes, and accelerating the modernisation of the signalling system.

Thirty billion euros of funding has been allocated to maintain the main network for the next ten years for the most used part of it. Hence, SNCF Réseau pleads to need more funds for renovation and modernisation of the network. In this context, In order to better prioritise the allocation of financial and industrial resources, the investment strategy is looking beyond traditional considerations of safety and technical operation to include parameters such as cost coupled with quality of service (socio-economic analysis).

SNCF Réseau's new multi-annual contract with the government intends to covers the total cost of the network, define productivity targets and quality of service. It also obliges the company to improve its asset management capacity in order to improve resource programming and predict transportation needs and infrastructure performance.

ARAFER, the regulator, has currently a limited role in the global economic regulation of the network (the legal frame focuses on the regulation of track access charges) and maintenance interventions do not fall within its scope. It was not involved in discussions around the multi-annual contract and has strongly criticised the content of this contract, mainly on economic targets of it. The French Parliament is considering new laws that will notably transform SNCF Réseau from a public operator into a publicly-owned limited liability company. A new approach to regulation would then be required and is desirable.

Regulation of the water industry in Scotland

Alan Sutherland
CEO, Water Industry Commission for Scotland

The Water Industry Commission for Scotland is an economic regulator that is purely focused on setting prices that ensure customers obtain value for money for water and sewerage services. In common with other economic regulators in the UK, we allow spending that is fully evidenced and effective. We set a hard budget constraint designed to foster innovation and efficiency. The regulatory process looks only six years ahead. This may mean that we are underfunding future asset replacement and storing yup large charge increases for the future.

If we continue to limit current funding to evidenced need over the regulatory control period, future generations may bear the substantial costs of replacing major infrastructure. Pension schemes provide a good analogy for this situation. Just as actuaries examine pension funds, so regulators could review whether sufficient funds are being put aside to cover future needs, without being prescriptive about how that money is spent. The challenge is to fund future work and maintain the hard budget constraint that encourages innovation and efficiency. Scotland is trying to solve this challenge and move away from the model of period-by-period settlements in order to share the costs of use and replacement across generations.

EU directives on water quality and environmental improvement are the largest single driver of investment in the Scottish water industry, which has around 2.5 million connected properties. Four to 4.5 billion euros have been invested over the last 15 to 18 years and 75% of water treatment works in Scotland are less than 40 years old. Although the civil engineering structures are sound, process engineering and instruments that typically have an asset life of 20-25 years account for 60-65% of the asset base and 75% of industry assets are buried under the ground. At the current time we believe that the efficient replacement cost of the industry's assets is in a range from £50-70 Billion. The required annual expenditure will depend on both asset life and the proportion of each category within the industry wide asset value.

Discussion with the floor

As there are good ways of detecting and predicting maintenance requirements, political short-termism and insufficient regulation are the only explanations for sub-optimal maintenance choices. Is it possible to drive greater efficiency in maintenance through competition? Does the level of competition on the downstream service market influence the upstream maintenance decisions made by infrastructure managers?

Bryan Kogan

Infrastructure maintenance is necessarily a long-term business. Relaxing the regime for a year or two has little impact so it can be tempting to take a maintenance 'holiday' when funds are short. If this approach is allowed to persist, significant deterioration can occur.

The ORR tries to encourage competition between infrastructure managers but it is difficult. Demonstrating the potential to reduce maintenance costs requires a good understanding of the asset's condition and the ability to make comparisons between performance on different parts of the same network.

Michael Robson

In Europe, infrastructure maintenance is either done almost entirely by the infrastructure manager with small specialisms outsourced or entirely outsourced or through a blend of these options. Contracting out can be effective but it is advisable to maintain part of the network in-house as a control and the network manager must retain responsibility for the quality of the infrastructure.

All parts of the UK use the same rolling stock but the cost of maintaining it and the miles per casualty on similar services vary dramatically. Performance regimes must take account of the different needs of different operators. For example, freight operators tend to be inconvenienced by night maintenance works.

Before 2005, it was difficult to persuade people that the French track network was deteriorating and not adequate for the rolling stock. Have these problems been resolved?

Jean-François Ducoing

The government is taking action but more money is required and regulatory clarity is also necessary. It is difficult for the State to be an effective regulator as it must juggle many competing priorities. That is a reason why the regulator should have a new role in this domain.

2nd roundtable : Reshaping Investment Policy

The impact of renewables deployment on the power sector in the US

Matthew Wittenstein
Senior Electricity Analyst, International Energy Agency

Under the Sustainable Development Scenario of the 2017 World Energy Outlook (WEO), the power generation system should be almost completely decarbonised by 2040, which implies a significant increase in renewables and low-carbon generation. Analysis of market- versus policy-driven investments in the US shows that, around 1990, the bulk of investments in the power system moved away from coal and nuclear and into natural gas and renewables. In doing this, the investment community moved towards less capital-intensive, more flexible technologies like natural gas but also, driven by policy, towards capital-intensive technologies such as wind and solar PV that tend to require higher upfront investment but have relatively low operating costs.

Policy interventions and market structure can have a significant impact on the shape and nature of investments. In OECD economies, there is a significant decline in investments relative to retirements in wholesale market environments due to the impact on wholesale electricity prices of overcapacity, stagnating or even declining demand, and the increasing share of renewables in the power system. The wholesale electricity market alone is not sufficient for cost recovery for a typical power plant, so regulators must ask whether additional mechanisms and interventions are justified to ensure long-term cost recovery. While it is important to maintain supply, inefficient measures could slow the transition to a low-carbon future.

Examples from Texas, and PJM offer different pictures of how to address the question of incentivising investment in generating capacity. The ERCOT market in Texas is an energy-only market, with a price cap of 9,000 USD/MWh. Over recent years the number of hours of high prices in the Texas wholesale electricity market has been declining. More recently, a number of announced retirements are expected to have a significant impact on the amount of capacity available to meet peak demand. Thus far, Texas has declined to enact policy measures to address this.

Analysis of the ratio of capacity, energy and other revenues for plants in the PJM market over the last decade shows that while capacity revenues have remained relatively stable in absolute terms, energy revenues have been steadily declining. As a result, the share of capacity revenues has been increasing as a percentage of total revenues. It is possible that additional revenues will be required to ensure that all plants are revenue-sufficient over the long term.

Shifting focus away from the bulk power system, the rise of distributed generation is raising questions about the role of the distribution system operator. New York, for example, is considering ways to transform the distributed system away from its traditional role to

a platform for power services. This potentially creates a market for non-traditional participants to compete to provide services. One key question is whether the value of these additional services will be significant enough to outweigh the loss of traditional regulated revenues.

How do you think storage and declining renewable costs will change our perspectives on system reliability?

Matthew Wittenstein

There are two main ways that storage can play a role in power systems. One is as a market participant, and the other is as a regulated asset treated in a similar way to, for example, investments in transmission.

Storage can be a generator, a consumer, and a T&D deferral. Its many different value streams and roles create challenges for regulators. How do you think this situation will develop?

Matthew Wittenstein

Regulatory decisions will have a significant impact. One role for storage as a market participant is to take advantage of arbitrage opportunities - that is, to take advantage of price volatility in order to recover the cost of the investment. The ancillary services market is another possible area where storage can play a role, if it is allowed to. The regulator needs to ensure that market rules allow storage to participate.

With regard to avoided asset investments, experiences from pilot projects that I have seen suggest that there is a reluctance to allow storage to play a bulk role. There needs to be more risk-taking and a willingness to believe that consumers will bear higher costs for this technology. The grid will play a critical role in a high renewables future, but there is significant opposition to grid development in many countries. Storage may be a suitable alternative.

Montserrat Ramiro Ximenez

Storage is also cost effective, particularly as the technology develops. As battery capacity increases, it is possible to shape the load curve more effectively and create more space for renewables. Regulators should be open to being wrong about costs and outcomes. In the US and Mexico, regulation is technology agnostic.

Matthew Wittenstein

Theoretically, batteries could deliver a completely flat load curve but this would eliminate opportunities for arbitrage and associated economic incentives. Other technologies are focused on flattening the peak and affecting arbitrage in the other direction. It will be interesting to see how these competing goals play out.

Do your comments about jurisdictions that are re-thinking the role of distribution companies relate to distribution system operators or to supplier companies? In the EU, there is an active debate about who should play these important service roles in a competitive market.

Matthew Wittenstein

I was referring to distribution system operators and more traditional regulated market participants. New York is exploring whether it is possible to transform a traditional distribution company into more of a fully-fledged system operator and create a market in which anyone can participate.

The Australian transmission and distribution system

Michelle Groves
CEO, Australian Energy Regulator

Australia's national market is composed of a mixture of private and state-owned companies, all of which are regulated using a framework based on a benchmark efficient private firm. State-owned companies receive the commercial rate of return, but are also expected to achieve commercial rates of productivity and efficiency.

There are concerns by some stakeholders about possible over-investment in some parts of the network. Recent work by the Grattan Institute claimed that around half of the 40 billion AUSD increase in the regulated asset base over the last decade is thought to be over-investment; 19 billion AUSD of it is in state-owned jurisdictions. The incentive-based regulatory framework works extremely well for companies that are driven by commercial incentives but less so for state-owned businesses that have broader incentives that vary over time. The framework is being adapted to increase efficiency in this area. Investment was influenced by government responses to public concerns about reliability but approaches based on risk and cost-benefit analyses are now dominant.

There is a very strong separation of the natural monopoly elements of the market. The regulator sets revenues for network businesses every five years on an ex ante basis using an incentive-based framework. Network businessess receive an agreed total revenue to use as they see fit within the constraints of applicable standards and regulations. Revenues are guaranteed on the basis of the regulated asset base and there is no ex post optimisation of assets. Businesses are allowed to keep the benefits of efficiency gains during the period but revenues are then adjusted based on revealed cost information and any gains are passed on to consumers. This framework worked well for the private sector but, for a number of businesses, in particular, state-owned companies, the reliance on revealed costs to set revenues was not driving efficient outcomes.. Benchmarking was used to set operating expenditure and significantly reduce baseline figures for the businesses that were outside of an efficient range. Revealed costs will be used going forward. Various schemes seek to ensure that savings derive from genuine efficiency gains, equalise efficiency savings over the period, and maintain quality of service.

The regulator is also developing schemes for new emerging markets and services, including a demand management incentive scheme. To encourage competitive markets, all businesses are required to conduct public regulatory investment tests above certain thresholds to identify if any third party is able to provide the services in question. Ring-fencing and legal separation also limit the ability of established distribution service providers to restrict competition in emerging markets. The aim is that the new services should develop through competitive markets rather than through the regulated asset base, where customers would carry the risk. This is being done in metering, connection services and battery development.

In response to new, emerging generation and the retirement of old generation, efforts are being made to reshape the transmission system into an integrated system that incorporates renewable capacity and makes more efficient use of all elements. Challenges include the need to manage excess capacity in the network without affecting sovereign risk and undermining the regulatory contract between businesses and their customers while simultaneously supporting new investment to reshape the grid. The solution is likely to lie in a more collaborative approach and respectful relationships between the different parties.

BNetzA's role in energy infrastructure regulation and planning/ permitting

Annegret Groebel
Head of Department, International Relations & Postal Regulation, Bundesnetzagentur

Incentive regulation is intended to promote efficient investment and avoid over- and under-investment. The German incentive scheme encourages transmission system operators (TSOs) and distribution system operators (DSOs) to invest to meet the expansion in renewables. Investments are subject to efficiency benchmarks and there is a revenue cap for each five-year period to ensure that inefficient costs are phased out. Capex is considered to be partially controllable and falls under the efficiency requirement; this was controversial with operators. Incentive regulation is used to avoid over-investment. An efficient return on equity for each period is intended to avoid over-capitalisation.

The German incentive scheme covers four TSOs in electricity, around 16 in gas and 800 DSOs in each of electricity and gas. All of them expect fair and non-discriminatory treatment that reflects their specific characteristics. As a result, a relative 'x individual' efficiency target is calculated based on the gap between each company's performance and an efficiency benchmark, while 'x gen' target is applied across the board to reflect technological process and price developments in the energy sector. Individual networks are also assessed based on parameters specific to their activity.

Since 2016, DSOs have been entitled to invest and immediately activate the capital expenditure. There has been no change for TSOs. The efficiency benchmark includes a quality parameter. With regard to security of supply, SAIDI values remain high; this shows that operators' fears about the introduction of the benchmark were unfounded. Overall, the system works well.

To support efficient financing of investments and cover the entrepreneurial risk that is specific to network operation, the rate of return on equity has been fixed using the Capital Asset Pricing Model (CAP-M). The risk-free rate was fixed at a very low level for the third regulatory period, which began in 2018. New assets were intended to have a rate of return of slightly less than 7%, but this is currently being challenged in court. It is common to have an unusual gearing ratio of 50% equity and 50% debt in Germany, which is capped at a 40% share of equity that is subject to the rate of return. The remaining 10% is remunerated at a lower rate to reduce the over-capitalisation that tended to occur under the previous system.

BNetzA is involved in planning and permitting for high-voltage national and cross-border transmission lines that are intended to compensate for the closure of Germany's nuclear plants and the need to bring renewables from the North Sea area to the industrial heartlands in the south and southwest. Planning for grid adjustments is being conducted at a federal level to ensure speed and efficiency and there will be an obligation to invest.

Key regulatory challenges in Germany include the need to regulate a wide variety of grid system operators in a consistent but individual manner and the need to promote efficient grid expansion as part of a broader integrated energy strategy. BNetzA, as a regulator, aims to deliver effective incentive regulation to prevent over- and under-investment, leverage the rate of return on equity to avoid over-capitalisation, and manage the process of planning and permitting of the high-voltage grid efficiently to ensure that these instruments complement each other.

Investment for electricity infrastructure in Brazil: challenges for the regulator

Issao Hirata
Energy specialist, Agência Nacional de Energia Elétrica

Around 125,000 new consumer units connect to the Brazilian grid every month and demand for energy is expected to grow at around 4% per annum for the next decade. The energy mix is already fairly clean, with almost 82% from renewable resources. The country needs to expand its infrastructure rapidly while keeping prices affordable and the energy mix clean. The regulatory governance framework is driven by government policymakers while a central planning authority identifies future needs and sets out a roadmap for development. The independent regulator, ANEEL, then acts on the market via two institutions: an independent systems operator and the Brazilian market operator.

In recent years, an auction process has been used to ensure that demand is met by infrastructure expansion. ANEEL is responsible for defining the regulatory and technical approach and the auction is conducted by the market operator. Investors bid for concessions and authorisations which are then administered and regulated by the Ministry for Mines and Energy and ANEEL. Initially, ANEEL focused on economic regulation and efficiency, working via tariffs and incentives. However, the country's challenges have obliged ANEEL to adopt a broader approach, helping to set the direction of change and ensure that infrastructure is built.

There was a substantial increase in perceived risk for transmission system investments between 2013 and 2016 due to political and economic instability. The regulator used its legal powers, technical knowledge and data to reduce the impact of this instability by highlighting and helping to resolve market problems, gaps and bottlenecks for investors. For example, the regulator was able to streamline bureaucratic processes and clarify policy issues that were causing significant delays to new wind power plants coming on line.

To meet its energy objectives over the next decade, Brazil needs to invest around 100 billion USD. Most of the new capacity will come from renewables but nuclear and fossil generation and variable renewables will also be required. A successful auction last week indicates that renewables remain popular and that wind and solar can be expected to grow substantially in the coming years.

Governance of investments in infrastructure: energy networks in France

Dominique Jamme
Special Advisor to the President, Commission de Régulation de l'Energie

CRE regulates French energy networks and markets for the benefit of consumers. It has an advisory role in energy policy. TSOs own and operate the networks and are also the systems operator. DSOs have full retail market opening and are natural operators, independent from any commercial activities. Key issues are the relocalisation of grid scale production following the closure of coal and nuclear power plants and the increasing role of renewables. Production and flexibility are also decentralising and demand is changing due to the increasing role of demand response, storage, self-consumption and electric vehicles. Electricity demand in France is stabilising and gas demand is declining, which raises the risk of stranded assets. Private companies tend to have a biased incentive to invest as the market value of network operators is usually the regulated asset base multiplied by a factor of 1.2 – 1.3.

Certain regulatory approaches, such as benchmarking, are not possible in France, where TSOs and DSOs tend to be part of vertically-integrated companies and the distribution market is dominated by two very large operators. Nevertheless, studies indicate that the French companies are relatively efficient and cost-effective. Initially, regulation was favourable to investment and offered healthy rates of return and incentives as under-investment was the perceived risk when the market opened to competition ten years ago. This approach has been successful: international interconnections have been reinforced, two LNG terminals have been built and the market has shifted from five zones to one. The transmission tariff has increased by 30% in ten years and the market is successfully opened.

Opex investment regulation is primarily incentive based: operators keep gains made during the regulated period but also bear any losses. Tariffs are adjusted for the next period. Capex is regulated using the rate of return, with investments integrated into the regulated asset base. Reference costs have been set for investments in electricity and gas and large transmission projects, with operators allowed to retain gains and bear losses to encourage efficiency. Totex regulation is used for expenses that are prone to accounting arbitrage, such as real estate, vehicles and IT systems.

In the future, the regulator will need to avoid over-investment, apply robust cost-benefit analyses to interconnections, and ensure that political interference is eliminated from these decisions. Transparency must also be increased and TSOs and DSOs must be encouraged to leverage third-party options, for example in storage, when this is a more efficient choice for the consumer than investing in the grid. Investment in distribution is complicated by a concession regime that means local authorities seek to optimise their network but are not responsible for the associated costs. The regulator is developing reference costs for transmission projects and exploring whether it will be possible to extend the scope of totex. There will also be complex challenges associated with the relocalisation of production. Some aspects, such as

the scale and structure of nuclear closures and tendering for renewables, derive from public policy while other decisions will be taken by private parties. The regulator must decide how to deal with economic and locational signals, for example via connection tariffs and participation in network reinforcement costs.

Regulating the Australian telecommunications sector

Richard Home
Executive General Manager – Legal & Economic Division, Australian Competition & Consumer Commission

Around 10 to 15 years ago, the Australian telecommunications sector was fully privatised and largely competitive. The historic, incumbent operator owned most of the network but access was good and competition was delivering improvements in service while containing prices.

However, broadband access became a political issue. The government organised a tendering process aimed at improving the network and, when it was unsuccessful, decided to build its own national fibre-to-the-home network supplemented by wireless and satellite coverage to ensure 100% population coverage. This wholesale-only network would deliver competition at the retail level but not at the wholesale level. In practice, the new national broadband company was obliged to buy back connections from the incumbent operator, making this possibly the largest government investment policy ever conducted in Australia. About 45 billion AUSD was invested over ten years and it will take many more years to recoup this investment.

The project has had a dramatic impact on telecommunications regulation, which is administered by the Australian Competition & Consumer Commission. A unique regulatory model was created based on a 30-year access arrangement with wholesale access services offered on a two-part tariff made up of a customer access charge and a capacity charge. Prices for services were capped with initial prices based on comparable broadband prices at the time. There was scope for rebalancing prices over time, a revenue cap to protect consumers, and an allowance for the new company to roll its losses forward and recover them later. This regulatory model has remained broadly the same despite some policy changes and a series of significant challenges. Firstly, a high initial capacity charge has discouraged retailers from buying large quantities of capacity and compromised the quality of service delivered to early adopters. Secondly, high access charges mean customers are tending to rely on mobile broadband services rather than fixed. Thirdly, the company will be unable to recover the costs of the investment over its lifetime.

Discussion with the floor

How do you measure the quality of an investment? For how long can efficiency factor gains be retained in Germany? Why do you not set a percentage for share of equity rather than using three different rates?

Annegret Groebel

The investment formula includes a quality element that applies a bonus malus based on the SAIDI values. Efficiency gains can be retained by the operator during the first regulatory period and consumers benefit during the second regulatory period. Operators do not lose the profit they gain during the first period and they continue to benefit during the second period from the improved efficiency. Since 2016, DSOs have also been given a 'super bonus' when they are particularly efficient. At current rates, performing adjustments for inflation at the very end has a negligible impact on the final figure.

Montserrat Ramiro Ximenez

The regulation of investment policy is highly dependent on sector, local context and technology and there are many issues to be resolved. Regulation will always be an important way to maintain a level playing field between operators, bring certainty to investors and, ultimately, benefit consumers. It would be interesting at a future conference to consider the role of storage, perceptions of nuclear power generation relative to climate change, and the role of regulators and competition in telecoms.

Chaire Gouvernance et Régulation
Fondation Paris-Dauphine
Place du Maréchal de Lattre de Tassigny - 75016 Paris (France)
http://chairgovreg.fondation-dauphine.fr