IX CONGRESSO PORTUGUÊS DE SOCIOLOGIA
Portugal, território de territórios

ÁREA TEMÁTICA: Conhecimento, Ciência e Tecnologia [ST]

THE LIMITS OF EVIDENCE-BASED POLICY: AN ANALYSIS OF TWO DECISIONS OF TECHNOLOGY INNOVATION

BOAVIDA, Nuno F.F.G.

Doutorado em Avaliação de Tecnologia, CICS.NOVA e Direção Geral de Estatísticas da Educação e Ciência, nuno.boavida@campus.fct.unl.pt

MONIZ, António

Doutorado em Sociologia Industrial, CICS.NOVA, abm@fct.unl.pt

LARANJA, Manuel

Doutorado em Gestão, ISEG-UL, mlaranja@iseg.ul.pt

Resumo

Apesar da crescente pressão para a tomada de decisões políticas com base em evidências, o conhecimento relativo à utilização na prática de evidências na decisão política continua a ser limitado. Este artigo investiga as melhores evidências disponíveis em dois cenários de decisão de investimento em inovação tecnológica: um relativo a uma política nacional de mobilidade elétrica e outro relativo à criação de um laboratório ibérico. O trabalho testou se a falha na utilização das melhores evidências disponíveis num cenário de decisão indica que as evidências foram selecionadas com fins políticos. Os resultados do primeiro estudo de caso mostram que as melhores evidências disponíveis não foram deliberadamente utilizadas. De facto, três evidências científicas formais e uma previsão de crescimento disponíveis na literatura cinzenta foram propositadamente ignoradas. Evidências adicionais foram produzidas e introduzidas mais tarde na fase de debate para justificar a decisão. Na segunda decisão, as melhores evidências disponíveis foram utilizadas com diferenças significativas nos dois países que tomaram a mesma decisão, tendo sido detetadas diferenças relativamente aos tipos de evidências, tipos e número de fontes e na profundidade da informação utilizada. A utilização de evidências esteve relacionada com as necessidades de justificação do mesmo investimento em diferentes cenários de decisão. Este caso revela que para compreender os limites da utilização de evidências em política de inovação tecnológica é mais esclarecedor procurar as melhores evidências possíveis do que as melhores evidências disponíveis.

Abstract

Despite increasing calls for evidence-based policies, knowledge about the practical use of evidence remains limited. This study investigates the best available evidence in two policy settings of investment in technology innovation: an electric mobility policy and the creation of an Iberian laboratory. The work tested if the failure to use the best available evidence in a given setting points to the use of evidence for political ends. Results from the first case study show that the best available evidence were deliberately not used. In fact, three formal scientific studies and a forecast from grey literature were purposefully ignored. Additional evidence were produced and brought later in the debate phase to justify the decision. In the second decision, the best available evidence were used with significant differences between the two countries making the same decision, but with marked differences in relation to the types of evidence, the type and number of sources and the depth of information used. The use of evidence depended on the needs to justify the same investment in two different policy-making settings. The case reveals that to understand the limits of evidence-based policy is more enlightening to consider the best possible evidence instead of the best available evidence. Research also revealed the need to develop more research about the importance of relational tacit knowledge in these decisions.

Palavras-chave: Política baseada em evidências; Melhores evidências disponíveis, melhores evidências possíveis; Inovação tecnológica; Indicadores

Keywords: Evidence-based policy; best available evidence, best possible evidence; technology innovation; indicators

[COM0302]

1 The use of the best available evidence in policymaking

The use of evidence[1] in policy-making has seen a growing interest in recent years. Several researchers reported an increase in calls for public policies that use evidence, particularly in countries were significant transparency and research culture exists towards policymaking (Head 2010, Flitcroft et al. 2011; Juntti et al. 2009, and Sorrell 2007). Despite these calls, however, knowledge about the use of evidence in practice remains rather limited. We know very little about policy makers' use of information in policy practice, how information is valued and, in particular, what is the prevalence of formal scientific evidence use in policy decision (Hall and Jennings 2010).

There is an abundance of types of evidence that limit the ability to report their use. An evidence for policy can be an indicator, a historical fact, a statistic[2], a result of an experiment or a test, a quote from secondary sources, a real experience or an opinion of an individual with expertise in a field. What constitutes evidence can vary with the policy context: In general policy-making, evidence can range from numerical data to ethical/moral interpretations expressing values, attitudes and perceptions of stakeholders and other decision makers. In health contexts, evidence can be research findings, other knowledge that is explicit, systemic and replicable, or simple acceptable waiting times (Lomas et al. 2005). In public management contexts, evidence can include costs, technical characteristics of materials, stakeholders' opinions, etc. Thus, the vast scope of types of evidence in policy making hampers reports about their use.

The amplitude of these scopes for evidence can be worrying. In one extreme, evidence can be strictly identified with scientific outputs. In this case, evidence comprises all types of science (and social science) knowledge generated by a process of research and analysis, either within or without the policy-making institution (Juntti, Russel, and Turnpenny 2009). On the other end of the spectrum, evidence can be interpreted as pieces of information useful to support policy. In this case, an evidence is not necessarily only data or information, but can also be a selection of the available information introduced in an argument to persuade about the truthiness or falsity of a statement (Flitcroft et al. 2011). Furthermore, the strength and quality of evidence can be related to the number of controversies that it goes through during its lifetime (Sébastien and Bauler 2013). In some cases, evidence loses strength through the controversies it triggers since its introduction in discussion. Thus, the scope of what constitutes an evidence can be significantly vast to discourage report and needs a narrower definition.

The use of evidence in policy-making can be a significant subjective and complex process. We know that policy emerges from the interaction of different forms of evidence, filtered and shaped by the institutional processes of decision-making (Flitcroft et al. 2011). These filtering processes are subjective and an evidence can be chosen instead of another, leading the argument in different directions. The selection of evidence is also dependent of political, economic and social/organizational (qualifications) context of the decision maker (Meijer, Hekkert and Koppenjan 2007). Furthermore, the selection of evidence can depend on the situations in which policy makers find themselves. These situations shape which information is used from the complex set available, and which evidence is rejected or at least downplayed (Perri 6 2002).

Last but not the least, the selection of evidence can be related to epistemological choices of the decision maker, in terms of claims about valid sources of knowledge and how to judge knowledge claims. These choices, for example, can be related to the use of quantitative data, qualitative information or even theological claims to knowledge. These choices often reflect ontological assumptions about the objectivity or subjectivity of reality. For some, only positivistic techniques of inquiry support claims to knowledge as reliable facts, whereas for others the complexities of the social world demand an interpretation of human behavior and intentions (Henn et al. 2009).

To overcome these obstacles, we will consider evidence as only the outcome of efforts to quantify or describe an identifiable characteristic of a phenomenon. We will also consider that a rationale needs to exist to support a policy decision, within a political, economic and social/organizational context.

An objective policy and practice based on evidence needs to combine different types of evidence from many sources acceptable in the settings in which they are applied (Montuschi 2009). However, the act of selecting and combining is not neutral. Knowledge utilisation approaches assumed a voluntarist attitude to policy-making where decision-makers act rationally and want to maximise the use of evidence. These approaches ignore the primacy of politics in government decision-making, and the many other factors that might impact on the way evidence is filtered, shaped or rejected (Flitcroft et al. 2011, 1040). Thus, there is the need to uncover the role politics and other factors play in the use of evidence.

This role can be identified by a retrospect analysis of the use of evidence in policymaking. In one survey to American institutions, Hall and Jennings (2010) found significant difference in decisions using formal scientific information and other sources, by area of intervention and type and number of information sources. The authors hypothesized that the failure to capture the "best available evidence" in a given field could point to the use of evidence for political ends, which continues to be one of the chief criticisms of evidence-based policy and practice. To test this hypothesis is necessary to re-construct the evidence available in each policy setting and determine if the best available evidence was used as the combination of all types of evidence available in a policy setting.

2 Methodology

The aim of this paper is to determine if the best available evidence was used by analyzing two policy settings related to policy investments in technology innovation. The in-depth analysis of these processes in retrospect will provide qualitative insights about policy makers' political intents and the role of other factors regarding the use of evidence. It will determine the use of information in practice, how information is valued and the prevalence of formal scientific evidence in the policy decisions.

The two case studies selected were part of a research project aimed to understand the use, influence and role of indicators in decisions of technology innovation. The first case was a policy decision to build an electric mobility infrastructure across Portugal. The case of electric mobility is a frequent example of innovation in the S&T literature, and a preliminary examination in the media revealed frequent use of evidence. The second case study was related to the creation of an Iberian nanotechnology laboratory. A preliminary scrutiny revealed two setting for the same decision, a small number of decision makers, and geographically accessible. The selection of both cases also considered operational restrictions, such as the possibility to review documents and access to potential data and records, as well as the ability to contact and interview decision makers. In addition, it should be noticed that policy makers were a difficult group to investigate because they revealed the need for more secrecy, were less prone to answer surveys and needed substantial explanatory contextualization of the research project.

In-depth interviews were conducted to answer the open questions about the context of the decision in relation to the political, economic and organizational contexts, the rationale and the use of evidence. All interviews lasted at least one hour to establish a trustful relationship with the interviewees due to the sensitive nature of the information requested, avoid any suspicion of misuse of information, and provide confidentiality to sources when that was possible. The interviews provided space for other questions to arise, to reveal insights and to enable the collection and triangulation of information until saturation of information was felt.

The first case study on electric mobility included nine in-depth interviews to decision makers: one to researchers, four to business R&D&I leaders and four to policy makers. These interviews lasted from one hour up to four hours, and were conducted between February 2011 and March 2013. In the end, two

complementary interviews were made to scholars with expertise on the case in March 2012 and in April 2013. The second case about the nanotechnology laboratory included four interviews with decision makers: two with researchers and two with policy makers. These interviews were conducted in March 2014 and lasted from one hour up to three hours. In the end, one complementary interview was made with a scholar in March 2014.

3 The electric mobility case

3.1 Context and rationale

The Mobi-E programme was a governmental decision to install 1350 charging posts for electric vehicles spread across Portugal. Its pilot phase ended in June 2011, with the full implementation of 1300 slow charging posts and 50 fast charging stations in streets, public parking lots, service stations, airports, hotels and shopping centres[3]. A payment system was also implemented to connect personal communication devices (e.g. tablets, smart phones, etc.). By enabling the user to select the most appropriate operation, the system allows for an analysis of mobility costs in order to optimize energy consumption[4]. The charging stations of Mobi-E were supported by the government, through a public innovation support fund created as a counterpart for the granting of wind power licenses (Godinho, Mamede, and Simões 2013). The power company EDP also made initial investments to supply electricity and continues to support the maintenance of the system (costs of around 600 000€/year[5]).

The political context was significantly stable, with a single party government supported by a clear majority in the parliament. At the time, there were favorable economic forecasts until the Portuguese financial crisis started (2010–14). The policymakers working in this decision were oriented towards investments in technology and renewables. The government supported policies towards renewable energies, and believed that they could give a technological push to promote development of the country. At the same time, Portugal was increasingly dependent on costly oil imports that called for measures to de-carbonize the transport sector.

In 2008-09, the government decided to create a working group on electric mobility and to develop infrastructure for street charging of EVs across the country.[6] The decision network was composed by both public as well as private decision makers, in a public-private partnership with a group of mostly Portuguese companies. The interaction among member of the decision network can be traced back to at least 2005, where the government started to think about electric mobility. The qualifications of the members of the decision network were Bachelors or Master in Engineering.

The rationale of this decision, or the articulation of the reasons for making this particular decision instead of others, included the need to decrease Portugal's oil dependency.[7] It also included the connection between electric vehicles and the investments being made not only in wind power but also in the linkage between wind and hydropower energy (ample in the country). A central argument used to justify the decision was that "the lack of a recharging infrastructure deters the acquisition of electric vehicles" (Pinto et al. 2010, p.15). There were also narrative elements and some very optimistic stories bordering unrealistic claims. The narrative elements included a vision of future where silent cars would be the edge modernity and development. At the same time, this narrative included also some future technology possibilities, such as the ability to link charging electric vehicles with renewable energy production at night time, as well as the possibility to sell energy to the grid from the battery of the car. Furthermore, the rationale included also some unrealistic claims, such as the overoptimistic range of 200Kms for Nissan Leaf advertised throughout the programme. In fact, the prime-minister's occasional use of the Leaf conveyed the erroneous idea that this specific car could be permanent car for governmental entourages.

The analysis also revealed that relational knowledge (Collins 2010) was a major determinant in the rationale of policymakers to make this decision. In fact, this type of tacit knowledge was developed through strong social interactions between government members and a leading director of Nissan-Renault. The information conveyed included details about the time to launch Nissan Leaf and the charging needs of this specific car, later used to determine the launching of the Mobi-E and the specifications of the electric chargers spread throughout the country.

3.2 Best available evidence

The main (formal) evidence used in practice was an indicator of market penetration of electric vehicles in 2020. This forecasted indicator was based on very optimistic scenario produced by the government and it pointed to a market of 750 000 electric vehicles in the country in 2020 (Mobi-E 2010). However, there were other existing formal scientific evidence at the time. For example, in 2009 a master dissertation by Paulo Santos on this very topic forecasted 600 000 electric vehicles in 2020 (in a very optimistic scenario) (Santos 2009, 40). Later, in 2010, another master dissertation by Luís Gomes again on this topic forecasted less than 322 027 electric vehicles in 2020, with a penetration rate of 50% (Gomes 2010). The governmental forecast was considered too optimistic because it represented 80% of the sales in 2020 (considering a sales growth rate of 1%). Interestingly, the most pessimistic scenario of the two pessimistic considered in the Santos (2009) study mentioned above, predicted a meagre presence of electric vehicles in 2020 with only 80000 units. Santos described this latter scenario as "catastrophic", given the "significance of public and private investments expected" to create the infrastructures and fiscal benefits to acquire electric vehicles (Santos 2009, 44). Santos also added that this was a very unlikely scenario, "justified by the non-acceptance of this king of technology in the automotive market" (Santos 2009, 44). Thus, two publicly available scientific evidence, revealing significantly optimistic forecast, were ignored.

Other evidence from grey literature also exposed the optimistic nature of the government's forecast. In fact, an expert from the Portuguese Automotive Business Association – a business lobby - reportedly stated that in a 'very' optimistic scenario 300 000 vehicles were expected to be sold in the year 2020 (Santos 2009). This forecast implied an optimistic increase both supported in the ratio population/sales of cars existent in countries like Belgium and the Netherlands, as well as in the assumption that in 2020 Portugal will reach these countries' economic and social development (Santos 2009). Therefore, existing evidence from grey literature was also ignored by the government.

Decision makers also ignored other existing scientific evidence about previous failed forecasts. In fact, Midler & Beaume (2010) reported the existence of three scientific studies in the United States predicting the introduction of EVs. The first one in 1973, elaborated by the Wisconsin University, forecasted a penetration rate of 20% of the total sales in 1980 in the USA. In 1979, a Princeton University study forecasted a slower penetration rate (10%) in 2000. Later, in 1994 the World Resources Institute predicted a 25% penetration rate in the US total sales in 2010. Thus, other failed forecasts existed in the literature and were also ignored.

The production of technical evidence after the decision was used to influence policymaking. In fact, two interviewees described that the decision was made not so much based on the technological effect of the policy, but rather on its political and social impact.[8] Technical evidence were sought only after the decision was made, according to interviewees. Furthermore, in this case and following strong controversies regarding the government indicator, additional evidence were solicited by policymakers and an excluded company. First, the government subcontracted a consultancy company to elaborate a technical study to support the investment decision. An international consultancy group was hired by the government to elaborate a technical report on electric mobility[9] about the potential market, the number of chargers for electric vehicles in the country and specifications for the charging stations. This report forecasted an optimistic potential market of 180 000 EV and Plug-in Hybrid Electric Vehicle for 2020, requiring 25 000 slow charging public

posts and 560 fast chargers in that year. This firm also calculated that EVs would be 11% more competitive than normal ICE to private owners and 12% to companies. Later, a company excluded by the programme Mobi-E and a major player in the energy market contracted another national consultancy to develop a technical study about quotas, market growth, its norms and how to regulate it. The study contracted by GALP showed that the penetration forecast of the electric vehicle would be significantly slow.[10 and 11] Some elements of the study benefited GALP's strategy in the short-term, and influenced policy-making in matters of market-share, norms and regulations related to EVs in Portugal. Forecasts were significantly cautious towards the growth of EV market (TIS.PT 2011), supporting the controversy about the initial governmental claims. Therefore, evidence was added after the decision to support government's decision and to defend outsiders' interests in the market.

In summary, the best available evidence at the time included three scientific works and a forecast from grey literature. Additional evidence was produced to support the decision. Interviewees confirmed that formal evidence were not considered in the decision process. Thus, the failure to capture the best available evidence in a given field points to the use of evidence for political ends.

4 The nanotechnology laboratory case

4.1 Context and rationale

The Iberian Nanotechnology Laboratory was an investment decision between Spain and Portugal.The idea to create an international nanotechnology laboratory, hereafter named INL, was approved in the 2005 at the Iberian Summit between Spain and Portugal. In the end of the Summit, the heads of state agreed to locate the facility in Braga, and nominated a Spanish to be its Director-General.[12] The decision involved significant negotiation activities between the countries and the national nanotechnology communities. It included the creation of a Bilateral Technical Committee and an International Consultative Council to help with the project.

In 2005, the political context of these countries was stable and their economic forecasts were favourable in both countries. The qualification held by these policymakers, were PhDs, as they were mostly Scientists making decisions in both countries.

The concept of an Iberian joint research laboratory was well received in both Spanish and Portuguese governmental circles for several reasons. The laboratory would cement relations between countries separated by historical events and not prone to cooperate beyond necessary issues. The cooperation would lead to the creation of the first international research institution in Spain or Portugal.[13] The research facility would also be dedicated to an advanced scientific area and an emergent technology. Last, the facility would be opened to participation of other countries, fostering international scientific collaboration.

The setting up on this laboratory included a visible rationale to justify the decision. It included a narrative about the importance to have a real international research centre for the first time in Spain as well as in Portugal. The narrative argued that other developed countries (such as the US, Netherlands and EU) were making significant investments in nanotechnology. The analysis revealed that Spain and Portugal had an urgent need to use the EU cross-border funds. Interviewees also indicated that there was strong relational knowledge in Brussels that determine the way the funds should be used. As in the former case study, the decision included unrealistic claims about the laboratory future connections to firms and industrial research. It also argued that nanotechnology was an emergent technology revolution.

4.2 Best available evidence

Evidence were after the decision to create the INL. Some evidence existed and was used about the international investments in nanotechnology, particularly in the USA but also at the EU level (Roco et al. 2000; Roco & Bainbridge 2003; Morrison 2005; Hullmann 2006). At the time, the USA prepared evidence to support the approval of a significant initiative in nanotechnology. Other countries in Europe followed and collected evidence to support their investments, such as The Netherlands. The history of the Dutch engagement with nanotechnologies as an important issue for consideration in society, politics and policymakers was done by the Rathenau Institute. A report from this technology assessment institute with evidence on the topic resulted in getting nanotechnologies on the public agenda, though without any explicit positive or negative undertone (Bijker 2014).

Further research on evidence use reveals significant differences in the collection of evidence in Spain and Portugal. In Spain detailed studies were conducted to determine the activities and necessities in the field and to map and improve technical skills and infrastructures in the following period of 2005-2010. An extensive study included quantified indicators at regional, national and European level (Correia et al. 2004). The study systematized the following indicators:

- cost of research projects, existing equipment and skills needed to operate them;
- number of researchers and technicians and skills;
- lists of equipment and projects existent in each laboratory; and
- skills required to operate equipments that already exist, ordered and might be ordered in future;

Spain also produced other public reports framing the investments in nanotechnology within the S&T system (Comisión Interministerial de Ciencia y Tecnología 2005a; Comisión Interministerial de Ciencia y Tecnología 2005b). At the time, investments were planned for six Spanish laboratories. To the central government, the INL was part of a larger set of investments that needed to be negotiated with the Spanish regions and their research communities (and later with Portugal). These negotiations required evidence that could be introduced in the assessment of the situation and the distribution of the investments.

In a different way, Portugal collected indicators of the costs associated to the creation of the Iberian Laboratory. The country did not produce studies on nanotechnology, despite investments in two new associate laboratories. In fact, only the technical committee preparing the INL creation collected elements to map the existing research activities in the country by research groups (INL Technical Committee 2006). An interviewee argued that the needs to justify the distribution of investments were lower than in Spain, and mostly directed to the Portuguese nanotechnology community. There was also a weak involvement of the general scientific community, which might justify their alienation from the project in Portugal.

No study was found in both countries that demonstrated an explicit opportunity of investing in nanotechnology and nanoscience versus other scientific areas. In fact, the justifications detected were based on the idea that the USA and other developed countries were investing in this research area. However, the same argument is also true for other research areas.

In sum, although both countries introduced evidence in the decision process, the production of evidence was different in the two settings: In Spain there were detailed preparatory studies with quantified indicators; in Portugal there were indicators of costs and mapping of research groups. Therefore, the best available evidence was used, although significantly different depth and types of evidence were found between the two countries. This difference means that within the same decision different settings

require different needs for evidence. Hence, evaluation of evidence use should be based on the best possible evidence for each decision instead of the best available evidence. In addition, the use of evidence was framed by the need or its absence to justify investments in the countries.

5 Conclusions and discussion

The analysis of the electric mobility case reveals that the best available evidence were not used. Three formal scientific studies were ignored, and a forecast from grey literature ignored. The main indicator used lost its strength in controversy about unrealistic forecast and over optimism. The controversies led to the production of new evidence by decision makers and also from an excluded company of the public-private partnership. Thus, it can be concluded that the failure to capture the best available evidence in this case points to the use of evidence for political ends, as hypothesized by Hall and Jennings 2010. On the other side, the analysis of the nanotechnology laboratory case revealed that the best available evidence were used. Interestingly, evidence were used differently in the two countries. The collection of information was particularly different, in terms of types of evidence, type and number of sources, and depth of information used. To conclude, the best available evidence is not a good concept because it is strongly linked to the national setting related to need to justify investments, to the culture of transparency and to the research procedures to assist policy making. A more enlightening alternative to understand the limits of evidence-based policy is to search for the "best possible evidence" found in each policy setting. This will allow a better analytical framework to account for the different efforts promoted by policy makers in a decision of technology innovation.

The two case studies argue for an use of evidence dependent of (i) the evidence's ability to support arguments and interests, (ii) the adversity (potential or real) perceived by policymakers of controversies and negotiations; and the accountability and transparency needs of decision makers. Thus, these results appear to be in line with the literature that described situations as an important factor influencing the role of evidence in policy making. The situations in which policy makers find themselves shapes the information selected from the complex set available and which evidence is rejected or at least downplayed, as advanced by Perri 6 (2002).

As a side note, results showed no particular differences in terms of qualifications. In fact, the use of evidence did not particularly increased when business engineers with bachelor degrees or academic scientists with PhDs turned into policy makers. At least for higher levels of education, the findings appear not to be in line with the Musso and Francioni (2012) idea that the educational level is significantly relevant to the decision-maker response. Last, the analyses of these cases argue for the need to conduct more research about the importance of relational knowledge existent in investment decisions of technology innovation. Both cases revealed that relational knowledge was critical to understand the driving motivations of the decisions.

Acknowledgements

Nuno Boavida was financed with a PhD scholarship from the Portuguese Fundação para a Ciência e Tecnologia (Ref. SFRH/BD/76200/2011). The author also would like to express his gratitude to the support of the Direcção Geral das Estatísticas da Educação e Ciência.

Bibliography

Bijker, W., 2014. Technology Assessment: "The State of Play - Towards a Hybrid and Pluriform Process of Governance of Science and Technology". In T. Michalek et al., eds. *Technology Assessment and Policy Areas of Great Transitions*. Prague: Informatorium, pp. 23–36. Available at: http://pacita.strast.cz/en/outputs/outputs-list/proceedings-from-the-pacita-2013-conference-in-prague.

Collins, H., 2010. *Tacit and Explicit Knowledge*, Chicago: The University of Chicago Press.

Comisión Interministerial de Ciencia y Tecnología, 2005a. *Memoria de actividades I+D+I. 2005*, Madrid: Ministerio de Educación y Ciencia. Available at: http://www.idi.mineco.gob.es/stfls/MICINN/Investigacion/FICHEROS/2005-memoria-i-d-i.pdf.

Comisión Interministerial de Ciencia y Tecnología, 2005b. *Plan nacional de investigación científica, desarrollo e innovación technológica (2004-2007) - Programa de trabalho para el ano 2005*, Madrid: Ministerio de Educación y Ciencia.

Correia, A., Hernández, J.L.R. & Domingo, P.A.S., 2004. *Estudios de las actividades y necesidades , en el área de las Nanociencias/Nanotecnologías*, Madrid. Available at: http://issuu.com/phantoms_foundation/docs/informe_nanospain_infraestructuras/1.

Flitcroft, K. et al., 2011. Getting evidence into policy: The need for deliberative strategies? *Social science & medicine (1982)*, 72(7), pp.1039–46. Available at: http://www.ncbi.nlm.nih.gov/pubmed/21419539. Accessed September 19, 2013.

Gault, F., 2013. *Handbook of Innovation Indicators and Measurement* F. Gault, ed., Cheltenham, UK: Edward Elgar.

Gomes, L.M.M., 2010. *O Veículo Eléctrico e a sua Integração no Sistema Eléctrico*. Master Thesis. Universidade Técnica de Lisboa.

Hall, J.L. & Jennings, E.T., 2010. Assessing the use and weight of information and evidence in U.S. state policy decisions. *Policy and Society*, 29(2), pp.137–147. Available at: http://linkinghub.elsevier.com/retrieve/pii/S1449403510000068. Accessed October 9, 2013.

Head, B.W., 2010. Reconsidering evidence-based policy: Key issues and challenges. *Policy and Society*, 29(2), pp.77–94. Available at: http://linkinghub.elsevier.com/retrieve/pii/S1449403510000020. Accessed September 19, 2013.

Henn, M., Weinstein, M. & Foard, N., 2009. *A critical introduction to Social Research* 2nd ed., London: SAGE Publications, Inc.

Hullmann, A., 2006. *The economic development of nanotechnology - An indicators based analysis*, Brussels. Available at: http://nanotech.law.asu.edu/Documents/2009/09/The economic development of nanotechnology - an indicators based analysis_220_7306.pdf. Accessed April 16, 2014.

INL Technical Committee, 2006. *Portugal-Spain International Research Laboratory - International Iberian Nanotechnology Laboratory (INL)*, Braga. Available at: http://www.umic.pt/images/stories/publicacoes4/80 Technical Committee Report.pdf.

Juntti, M., Russel, D. & Turnpenny, J., 2009. Evidence, politics and power in public policy for the environment. *Environmental Science & Policy*, 12(3), pp.207–215. Available at: http://linkinghub.elsevier.com/retrieve/pii/S1462901108001391. Accessed September 19, 2013.

Lomas, J. et al., 2005. *Conceptualizing and Combining Evidence for Health System Guidance - Final Report*, Ottawa. Available at: http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.112.4445. Accessed December 18, 2013.

Mamede, R.P., Simões, V.C. & Godinho, M.M., 2014. "Assessment and challenges of industrial policies in Portugal: is there a way out of the "stuck in the middle" trap?" In Aurora Teixeira, E. Silva, & R. P. Mamede, eds. *Structural Change, Competitiveness and Industrial Policy Painful Lessons from the European Periphery*. London: Routledge, pp. 1–21.

Midler, C. & Beaume, R., 2010. Project-based learning patterns for dominant design renewal: The case of Electric Vehicle. *International Journal of Project Management*, 28(2), pp.142–150. Available at: http://linkinghub.elsevier.com/retrieve/pii/S0263786309001173. Accessed April 29, 2013.

Montuschi, E., 2009. Questions of Evidence in Evidence-Based Policy. *Axiomathes*, 19(4), pp.425–439. Available at: http://dx.doi.org/10.1007/s10516-009-9085-0.

Morrison, M., 2005. *European Nanotechnology Infrastructure and Networks*, Brussels. Available at: http://www.nanowerk.com/nanotechnology/reports/reportpdf/report54.pdf.

Musso, F. & Francioni, B., 2012. The Influence of Decision-Maker Characteristics on the International Strategic Decision-Making Process: An SME Perspective. *Procedia - Social and Behavioral Sciences*, 58, pp.279–288. Available at: http://linkinghub.elsevier.com/retrieve/pii/S1877042812044643. Accessed September 19, 2013.

Oxford Dictionary, 2014. Evidence. *Oxford Dictionary Online*, pp.1–4. Available at: http://www.oxforddictionaries.com/definition/english/evidence?q=evidence.

Perri 6, 2002. Can Policy Making be Evidence-Based? *MCC: Building knowledge for integrated care*, 10(1), pp.3–8.

Pinto, M.C., Reis, L. & Neves, T.J., 2010. "MOBi.E.-The Portuguese Programme for Electric Mobility". In *European Transport Conference, 2010*. Glasgow, United Kingdom, pp. 1–19. Available at: http://abstracts.aetransport.org/paper/index/id/3437/confid/16. Accessed April 25, 2013.

Reiner, R. et al., 2010. *Challenges for a European market for electric vehicles*, Brussels. Available at: http://www.europarl.europa.eu/document/activities/cont/201106/20110629ATT22885/20110629ATT22885EN.pdf. Accessed May 23, 2013.

Roco, M.C. et al., 2000. *National nanotechnology initiative: The initiative and its implementation plan* M. C. Roco & W. S. Bainbridge, eds., Washington, D.C.: National Science Foundation. Available at: http://nano.gov/sites/default/files/pub_resource/nni_implementation_plan_2000.pdf. Accessed June 4, 2014.

Roco, M.C. & Bainbridge, W.S.W.S., 2003. *Nanotechnology: Societal Implication - Maximizing Benefit for Humanity*, Arlington, VA. Available at: http://www.nsf.gov/crssprgm/nano/reports/nni05_si_societal_implications_2005.pdf.

Roland Berger, 2009. "Modelo de Mobilidade Eléctrica para Portugal". In *Roland Berger Strategy Consultants*. Lisboa, Portugal: Ministério da Economia e da Inovação.

Santos, P.M.C., 2009. *O Automóvel Híbrido como Elemento Fornecedor / Consumidor de Electricidade - Modelação de Baterias de Iões de Lítio*. Master Thesis. Master Thesis. Universidade Técnica de Lisboa.

Sébastien, L. & Bauler, T., 2013. Use and influence of composite indicators for sustainable development at the EU-level. *Ecological Indicators*, 35, pp.3–12. Available at: http://linkinghub.elsevier.com/retrieve/pii/S1470160X13001775. Accessed October 3, 2014.

Sébastien, L., Bauler, T. & Lehtonen, M., 2014. Can Indicators Bridge the Gap between Science and Policy? An Exploration into the (Non)Use and (Non)Influence of Indicators in EU and UK Policy Making. *Nature and Culture*, 9(3), pp.316–343. Available at: http://openurl.ingenta.com/content/xref?genre=article&issn=1558-6073&volume=9&issue=3&spage=316. Accessed October 22, 2014.

Sorrell, S., 2007. Improving the evidence base for energy policy: The role of systematic reviews. *Energy Policy*, 35(3), pp.1858–1871. Available at: http://linkinghub.elsevier.com/retrieve/pii/S0301421506002667. Accessed October 9, 2013.

TIS.PT, 2011. *Transportes, energia e fiscalidade: Desafios e oportunidades perante a evidência da mudança*, Lisboa, Portugal.

[1] Evidence can be defined as the available body of facts or information indicating whether a belief or proposition is true or valid (Oxford Dictionary 2014).
[2] For the purpose of this work a statistic is a numerical fact or datum, especially one computed from a sample (Gault 2013).
[3] "Electric Mobility - Portugal Showcase to the World – Institutional presentation". 2010. GAMEP - Gabinete de Apoio à Mobilidade Eléctrica em Portugal.
[4] "Mobi-E Electric Mobility - Portugal Showcase to the World". Mobi-E. November 2010.
[5] According to 2012 costs.
[6] Resolução do Conselho de Ministros n.º 20/2009. Diário da República, 1.ª série — N.º 36 — 20 de Fevereiro de 2009.
[7] "Modelo de Mobilidade Eléctrica Para Portugal – Apresentação a Sua Excelência O Ministro da Economia e Inovação – Sumário Executivo". Presentation. Roland Berger Strategy Consultants. Lisboa. 14/1/2009.
[8] "Modelo de Mobilidade Eléctrica Para Portugal – Apresentação a Sua Excelência O Ministro da Economia e Inovação – Sumário Executivo". Presentation. Roland Berger Strategy Consultants. Lisboa. 14/1/2009.
[9] "Modelo de Mobilidade Eléctrica Para Portugal – Apresentação a Sua Excelência O Ministro da Economia e Inovação – Sumário Executivo". Presentation. Roland Berger Strategy Consultants. Lisboa. 14/1/2009.
[10] Interview 7, line 211-214 and TIS.PT (2011).
[11] At the time, Reiner et al. (2010) also forecasted an optimistic technology scenario where BEVs and fuel cell vehicles will have only 5% of market penetration in 2020 in Europe.
[12] Cimeira Luso-Espanhola. 2006. "Conclusões da XXIIª Cimeira Luso-Espanhola Badajoz, 24 e 25 de Novembro de 2006". Badajoz. Last accessed in 12/12/2014: http://www.erse.pt/pt/mibel/construcaoedesenvolvimento/Documents/CONCLUS%C3%95ES%20CIMEIRA_BADAJOZ_2006.pdf
[13] The Institute for Prospective Technological Studies located in Seville was only a European research facility of the Joint Research Centre of the European Commission.