The uncertain games of energy transition in the island of Sardinia (Italy)

Giorgio Osti

Dipartimento di Scienze Politiche e Sociali, Università degli Studi di Trieste, Piazzale Europa, 1, 34127, Trieste, Italy

A R T I C L E I N F O

Keywords:
Energy transition
Islands
Southern Europe
Independence
Development

A B S T R A C T

Energy is a basic issue for cleaner production and more sustainable consumption. A transition to renewable sources and massive energy savings face several problems: technological lock-ins, energy companies' oligopoly, unsteadily governments' policies. These problems are especially severe in small island developing states or regions. For these territories, however, energy transition can be a chance to improve their situation, especially if they are rich of renewable sources and they can mobilise important cultural and organisational resources, such as claims for identity and autonomy. An exemplary case study is Sardinia, the second biggest island in the Mediterranean Sea. It has problems of energy supply, strained political relationships with the mainland, and low economic development. The framework for this case study is rooted in multilevel perspective and political economy, complemented by games playing metaphor. The research hypothesis is that sustainable energy practices emerge if a variety of 'games' are visible, if they stimulate lay people participation, and if they are consistent with key goals for islanders, including independence, development and identity. In Sardinia, three games are identified: fossil fuels vs. renewables, competition on smart grid and storage system technologies, energy sovereignty vs. energy interdependency. There is not a single result of these games. Variable situations emerge, which allow forecasting a very slow progress of the energy transition.

1. The issue and the frameworks

1.1. Energy problems in islands

Cleaner energy production represents the main means of tackling climate change. The challenge is to combine an energy efficient industry with more sober consumptions (Dovì et al., 2009; Karunathilake et al., 2018). However, a transition to renewable sources and massive energy savings face several problems: strong technological lock-ins (Koster and Anderies, 2013), restraining interests of oil and gas industries (Gupta, 2017) and reduced investments in poorer regions (Bouzarovski and Tirado Herrero, 2017; Pellerin-Carlin, 2017). These problems are the most severe in islands that are far from mainland and suffer economic deficits. For this kind of islands, energy transition can be a chance to improve their situation, especially if they are rich of renewable sources and they can mobilise important cultural and political resources, such as search for identity and independence from nation state. The challenge for island local governments is to use the energy transition to improve the quality of life in more remote areas, enhancing participation to energy issues, and creating new jobs from renewables plants installation and maintenance (Osti, 2016b).

A possible side effect of energy transition concerns independence, both at a household (prosumer) and territorial level (smart grid, energy district). Increased supply autonomy, ensured by small-scale renewables and storage systems, can become an important goal for regional governments that are anxious to improve their own legitimacy.[1]

All these factors help to justify the aim of this paper: to study energy transition in a big island in order to see whether local institutions, utilities and civil society actors support best practices (Dornan, 2016; Beermann and Tews, 2017; Karunathilake et al., 2018). Islands, especially those that have an urban-rural divide and are located far from the mainland, appear to represent ideal sites for the study of the pace and extension of energy transition (Kaldellis et al., 2009; Bunker et al., 2015; Ciriminna et al., 2016;

E-mail address: giorgio.osti@dispes.units.it.

[1] "For all practical purposes politicians in the non-sovereign Caribbean aspire to maintain the many material advantages of the postcolonial bond, while at the same time securing maximum autonomy" (Oostindie, 2006 p. 612).

Santana Sarmiento et al., 2017). Insulation and distance necessitate greater effort at achieving energy secure provision.

Energy storage systems (EES) are deemed strictly complementary to islands' energy security, especially for those oriented to renewable energy sources (RES) and distributed generation (Bueno, Carta, 2006). EES are very flexible and are modularly arranged; Walker and Cass (2007) refer to them as the *hypersizeability* of renewable energy hardware. Thus, they are adaptable to every scale of energy distribution and cover the problem of RES intermittence. In this study, storage systems are considered a privileged indicator of rapid and full transition. Thanks to their generalised application, we consider it plausible that the ideal of 100% renewables or self-sufficiency can be attained in circumscribed places (Spector, 2017a).

According to the Rocky Mountain Institute, there are several obstacles for achieving this ambitious goal: energy technicians living far from the island, the difficulty to stabilise the island small grid, especially if fuelled with renewable sources, dependence on external grants or capitals for renewables plants, ESSs and energy saving measures (Bunker et al., 2015). These issues are more easily solved if the island is vast, connected to mainland grid and densely populated. This creates scale economies that are still an important requirement for most island energy systems (Agarwala, 2017). But, there is another important dilemma for islands: to increase the degree of self-sufficiency or to improve connection with other systems (storing versus networking dilemma). Such an issue can be developed through sophisticated algorithms measuring instantly the convenience of self- or grid provision (Amini et al., 2018) *and* studying the institutional and cultural conditions for investing in network or storage practices (Osti, 2016a).

Solving this dilemma is not easy. Islands suffer many integration problems: insufficient energy supply because old infrastructures; difficult political relationships with the mainland which is unable to recognise the special situation, low economic performance that reduces the chance to adopt good solutions like small scale renewables plants and ESS. Grants, civil society projects and public-private partnership become necessary for overcoming the island gaps. Several policies targeted the small islands (Chen et al., 2007; Dornan, 2015; Wolf et al., 2016), while it is more difficult to tackle the energy dilemmas of bigger ones or entire archipelagos.

1.2. An emblematic case study

Sardinia, the second biggest island in the Mediterranean Sea, has been chosen as a paradigmatic case study. It has problems of energy supply, strained political relationships with the mainland, and low economic development. The research hypothesis is that rapid, effective and sustainable actions emerge in the island if a variety of 'energy games' are visible, if they stimulate people participation, and they match the typical aims of the islanders, comprising independence, development and identity. Such aims can be perfectly translated into energy terms: energy self-sufficiency or autarchy, energy as a source of welfare and work, and innovative energy projects creating place pride and identification.

Starting from this introduction, the paper is organised as follows: section 1 describes the most relevant theoretical frameworks for interpreting the case-study, section 2 presents main data of energy transition in Sardinia, the possible sources of rapid change (energy accelerators) and the main energy games are been played in the island. Finally, in section 3 a discussion on the results and on future developments in Sardinia is presented.

1.3. Political economy and multilevel perspective

In order to understand whether Sardinia is moving toward a rapid energy change, we require a tailored theoretical framework. Generally, transition theory, also known as multilevel perspective (MLP), is used (Geels, 2010, 2011; Chapman and Itaoka, 2017). This theory conceptualises change as the passage of innovation from niche to regime level, that is, the realm of institutionalised rules governing the entirety of the energy system. Attention to consolidated rules, their field of application and the legitimation they receive from public and experts connote MLP as a neo-institutional approach (González, 2017). However, "analysts suggest the energy transition has become captured by incumbent energy policy networks [..], and suffers from a democratic deficit [..]" (Voβ et al., 2009, p. 285). The relevance of economic interests at the regime level highlights the strict public-private *arrangements* that are created in each country around energy provision. Thus, the political economy perspective should provide a more selective explanation (Mitchell, 2008), especially if inserted into a comparative framework (Trigilia, 2002), including the role of bureaucracy (Evans, 1989) and social movements (Podobnik, 2006). However, in turn, such an approach suffers from its exclusive focus on economic aspects, whereas energy issues include many other symbolic stakes. In an island like Sardinia, 'pride and prejudice' are important factors for understanding the adoption or rejection of a new energy project. In short, multilevel and political economy perspectives both insist on one mechanism: the possibility that new technical or economic organisations break a strong energy regime (*see* Owen-Smith and Powell, 2008). However, this dynamic is insufficient to acknowledging the great activism of energy movements or the wide and contradictory strategies of big energy players. More attention must be given to symbolic actions (as opposed to purely economic reasons) in the public arena, at a time when energy is considered a powerful tool for change.

1.4. Game/play framework

Previous perspectives can be enriched by paying greater attention to the *games* played by actors. Such a viewpoint does not belong to the prisoner dilemma tradition, but rather to anthropological studies (Huizinga, 2002), in which the terms of play (actor-oriented approach) and game (rules approach) are bound together. Eugene Fink (2008) lists the analytics of 'game world': pleasure, meaningfulness, sociability, rules, toys and role-playing. These represent useful ingredients for an articulated framework. We can add further conditions and qualities:

- The presence of one or more contests, disputes, races, competitions or conflicts;
- Recognised players: actors who have or pretend to have legitimacy to participate in the game;
- Playground(s): physical places equipped for matches;
- An arbitrator: a third party, generally a public body or an authority or a prestigious agency.

The qualities of game, which give playing meaningfulness and attractiveness, comprise:

- Publicity;
- Tokens: toys in game language (Fink, 2008);
- Reversibility or repeatability.

The qualities of game are more intricate than the conditions. Publicity concerns both the visibility of the game and the presence of a public that likes to see it as a show. Conflicts that occur in secret do not represent games but rather sordid battles for power. Game display is very attractive both for players and spectators. Of course, publicity is also at the base of the democratic rule of transparency.

This norm is additionally valid for companies in the moment that they decide to enter the stock exchange market or reach out to a wider audience of consumers.

Tokens or toys are those symbolic and practical tools that allow the game to be played in a satisfying way. After all, a good ball is necessary for a good football game. Nevertheless, the ball is also a symbolic object. In fact, remaining with the football analogy, the desired 'golden' ball is given to the best player, recognised worldwide. Tokens can accordingly be related to symbolic rewards. They belong to the world of gifts and liberality.

Reversibility or repeatability concerns two qualities of the game-playing metaphor. One is the adversary's power to reverse the result. This highlights the skills of players, their capacities to learn from mistakes and to resist. Reversibility is an important feature of energy-environment issues. The same idea of 'renewables' evokes opportunities to repeat the process many times (Erker et al., 2017). The other quality is the fictive nature of games. They represent a bubble of reality: the results of game are without real consequences; nobody is killed or loses money if he or she does not win. Of course, we know that many games do have a real stake – for example roulette – with real wins and losses. Fink and other authors, such as Winnicott (1971), insist on the game capacity to create an osmosis between reality and fiction, seriousness and frivolousness, vacancy and work. The uncertain border between game and reality is manifested in different ways: gymnasium of humanity, symbol of prestige, complementary sources of money, the sports industry, and so on.

This framework regarding game-playing does not exist in opposition to the aforementioned approaches. It simply broadens the range of motivations and mechanisms that intervene in the energy field. Utilities, consumers, authorities and companies do not obey to only one rationality: self-interest or uniformity in response to rules, just to mention political economy and neo-institutional approaches. Rather, they interact according to the pleasure of interaction, prestige of winning and search for sense-making tokens.

2. The case study: energy games in Sardinia

2.1. Hypothesis and methodology

According to game/play framework and the research topic (island energy transition as an opportunity for independence and development), the hypothesis can be formulated in the following way: *the speed and originality of energy transition is higher when a set of public, symbolic and frequently repeated games takes place*. A strong monopoly over the energy chain and consumers' passive attitudes towards climate change and fossil fuels do not provide effective conditions for starting a challenging game among players. These general statements will be adapted to the specific case of Sardinia.

The research method is based on 'case study'. This qualitative approach is recommended when "a holistic, in-depth investigation is required" (Zainal, 2007) and the research object is a complex organisation (Hartley, 2004). Single case analysis is frequently used in energy transition studies (Turcu et al., 2014). While this choice limits the possibility to formalise and generalise the results, however it allows to understand complex and emblematic situations. Sardinia, is an idiosyncratic case for history, relative distance from mainland, aspiration to independency. Furthermore, its large geo-demographic dimensions allow outlining both internal articulation and numerous interdependencies with external systems. Then, unicity, extension and high differentiation justify a holistic approach and a single case in-depth investigation.

Fig. 1. Solar radiation map of Italy. Source: http://www.mappery.com/map-of/Solar-Radiation-Map-of-Italy.

Table 1
Main demographic and socio-economic features of Sardinia, compared with Italy. Source: Istat.

	Sardinia	Italy
Population (end 2017)	1,648,176	60,483,973
Average income (euros 2015)	10,968	13,713
Average age	45.6	44.4
Foreigners (% 2016)	3.0	8.3
Unemployed (%, 2017)	17.0	11.2
Primary sector employed (% 2009)	5.8	3.8

2.2. Sardinia energy picture

Sardinia is the windiest region of Italy[2] and one of the best for solar radiation (Fig. 1). It is quite big (24,000 km^2), located far from the mainland (180 km at the closest point) and populated with more than 1,600,000 people. Furthermore, Sardinia has suffered in the past from issues of marginality, as well as colonisation by political and economic powers. Administratively, it is an Italian region with special autonomy from the national government. Socio-economic indicators reveal an area with numerous problems, the most important being unemployment, but also weak and polarised industrialisation and low incomes (Table 1). However, a strong indicator of welfare – life expectancy at birth – is similar to the national mean, and thus provides a sign that Sardinia cannot be assimilated to southern Italy where the general conditions of life are worse.

"Sardinia like Pellworm, the small German island that became completely energy self-sufficient thanks to the use of renewables. For the president Francisco Pigliaru freeing the island from fossils and subsequently also from methane" is plausible or at least represents a key goal (Redazione Casteddu Online, 2016). The words of the President of the Sardinia Autonomous Region provide a clear summary of how the local elite imagines energy transition. The island has a history of colonisation even recently with industrialisation. This explains the desire to become self-sufficient using RES. However, the picture of the near-future is not so clearly based on

[2] Interactive wind atlas of Italy: http://atlanteeolico.rse-web.it/index-en.phtml, accessed 9 April 2018.

Table 2
Number and capacity of photovoltaic plants and wind farms in Sardinia and Italy, 2012–2016 percentage variation, plants and capacity per resident 1.1.2016. Source: GSE.

	2012		2016		2012–16 (var. %)		2016	
	Plants number	Capacity (MW)	Plants number	Capacity (MW)	Plants number	Capacity (MW)	Plants/residents *1000	Capacity/residents*1000 = Kw
Photovoltaic Plants								
Sardinia	22,287	558.2	33,296	742.7	49%	33%	20.1	0.44
Italy	478,331	16,419.8	732,053	19,283.2	53%	17%	12.1	0.31
Wind Farms								
Sardinia	47	988.6	354	1011.5	653%	2%	0.21	0.61
Italy	1054	8119.4	3598	9409.9	241%	16%	0.06	0.15

RES. For the moment, the approved regional plan for energy forecasts the use of coal for a new power plant and the extension of natural gas grid to the entire island, building a new connection with the mainland or liquefied gas terminals in the seaports. Subsequently, the entire internal major grid must be created. “The Natural Gas should be the fossil energy vector for the transition to a decarbonised economy, progressively achieving wider quotas of total consumption to the disadvantage of oil, oil derivates and coal in the decade 2020–2030” (Regione Autonoma della Sardegna, 2015, p.4).

At the end of 2013 the final consumption of energy in terms of thousand tonnes of oil equivalent (ktoe) according to the regional plan was (Regione Autonoma della Sardegna, 2015, p. 20):

Transport 854 ktoe (all from fossil sources);

Electric 740 ktoe, 297 ktoe from RES and 443 from fossil sources;

Thermal 1081 ktoe: 421 from RES and 660 from fossil sources.

Furthermore, 561 ktoe are consumed for maritime and air transport to and from the island. 343 ktoe of electric energy are exported to the mainland and Corsica. It must be stressed that the majority of thermal energy coming from RES is constituted of biomass burnt in houses. Thus, electric energy (EE) is the vector through which RES with a low impact have their main application. Biomass is included in RES but it has a greater impact on air and land use. On a rural island like Sardinia their use is quite common. Finally, one has to consider the large quota of energy of fossil origin absorbed by transport means. Nevertheless, in 2013 Sardinia largely overcame the 17.8% quota of Final Gross Consumption from renewables assigned to it by the Ministry Decree of 15 March, 2012, ‘Burden Sharing Objective’. In general the island is moving towards the 20-20-20 goals of the European Union (Eurostat, 2017): RES constitute about 24% of the total energy consumed (Regione Autonoma della Sardegna, 2015). In 1990, Sardinia's CO2 emissions totalled 15.89 million tons, then 13.31 million tons in 2013; they have decreased in a remarkable way: −16.2% (Regione Autonoma della Sardegna, 2015, p. 23). Improvements in terms of energy efficiency are less identifiable: there are no direct indicators. According to an assembled *Index of energy efficiency policies penetration,* calculated by ENEA (2015, p. 199), Sardinia's value of 0.37 is below the national average of 0.42, with Italy's regions ranging from 0.22 to 0.62.

Electric RES represent a very small quota of the energy consumed by the region: 297 ktoe of a total of approximately 3,000, less than 10%. It is easier to study electric RES because their provision and consumption are more accountable. Moreover, the energy budget of electricity is more recent: 2015 (Renzi, 2017). Of 12,465 GW h (GWh) generated, 9080 are from fossil sources, while 3386 come from RES. If we subtract consumption for auxiliary services and pumping (847 GWh), as well as transmission losses (466), the internal consumption amounts to 8870 GWh. It is worth acknowledging that a considerable amount of EE is exported (2,749), a quota of around 25% of total net production.

The supply of EE from RES reached its peak in 2013 with 4000 GWh, before declining a small amount. In contrast, the supply of EE of fossil origin has decreased by a considerable 33% since 2006. It is important to explain why RESs has only experienced a small decrease in Sardinia, in spite of their dispatching has a priority on EE supplied of fossil origin. Main reason is that the economic crisis reduced demand; other reasons are meteorological or related to low plant maintenance and revamping, especially for wind turbines.

Sardinia's wind farms experienced an increase in the number of plants in the period 2012–16, although in terms of capacity the trend has been fairly static (2%) (Gse, 2017). This differentiates Sardinia from Italy where the growth in capacity has been more significant (Table 2). Nevertheless, both Italy and Sardinia experienced rapid diffusion before 2013, the year that can be considered the turning point when Government decided to stop generous subsidies on renewables.

Photovoltaic (PV) panels are less concentrated than wind energy. Their modularity in terms of scale and placement is easier to manage than in the case of wind farms. This has permitted constant growth, although following cuts in incentives their diffusion slowed as well. They are more widely distributed in Sardinia than is typical of Italy in general: Sardinia registers 19 plants every 1000 inhabitants, far above the Italian average of 11. Accordingly, the mean capacity of PV plants in 2015 was 23 Kw in Sardinia and 27 Kw in Italy. Sardinia is distinctive in its prevalence of panels placed on greenhouses: at 28% it has the highest quota in the country, far above the national mean of 6% (Gse, 2015, p. 22).

The landscape of RES in Sardinia resembles a mixture of north and south Italy. Sardinia lacks the sheer density of wind farms and land PV panels that characterises Apulia in the south, or the density of very small roof PV panels of some of the north-eastern regions. FV greenhouse specificity is ambivalent because in many cases cultivation under the panels has not begun.

2.3. Accelerators of energy transition in Sardinia

Sardinia is neither a champion of RES nor of energy-saving or storage. It stands in an intermediate position relative to other Italian regions. This leads us to conclude that in spite of its considerable solar and wind potential and its general insularity, energy transition has been a slow process. The rapid growth of wind and PV farms at the beginning of the 2010s did not cause a regime change. Rather, it was the fruit of the generous feed-in-tariffs (FIT), a national policy without any special attention or redistribution of resources to marginal areas, like Sardinia or southern Italy.

However, at the national level the role of Transmission System Operator (TSO Terna) should be mentioned. It is a state-owned company and it works as a monopoly regime, assuring high EE voltage across the national grid. Sardinia has been the object of large-scale interventions in the past and today new measures are being planned. In 2011 Terna built SAPEI, an electric bridge with a capacity of 1000 MW and a cable of 435 km, directly connecting Sardinia with the Italian mainland and crossing the sea at a

maximum deep of 1,640 m.

In order to achieve greater grid stability, Terna has created an experimental storage laboratory in Codrongianos in northern Sardinia, where the other cable, SA.CO.I. arrives.[3] This complex storage system has a capacity of 7.4 MW and a further 0.4 MW are under construction (Terna, 2016). In this laboratory of real dimensions, several storage technologies of different global companies are used, even if the Lithium-ion battery prevails. Terna insists on the idea that Codrongianos is a multi-technological pole, i.e. it has not definitively selected one kind of technological package. Storage technological neutrality versus the clear preference for one type is an important element of national policy, linked to each industrial tradition. Italy, unlike Germany or Japan, has not championed a particular storage technology (Osti, 2016a). Rather, the national government and energy authority assure great freedom to choose the technological storage package utilities and companies prefer. At the same time they do not incentivise anyone to adopt storage systems.

Terna is thus highly committed in Sardinia. Its actions are twofold: to increase interdependency with mainland and to start storage applications above the laboratory-experimental level. Terna is working accordingly in southern Italy, where the provision of energy from wind farms is consistent, too. Such commitment to storage at the distribution level is the purview of the grid distribution owner, generally Enel[4] in the case of Sardinia. At that level, prosumers can adopt storage systems, too. We are not aware of Enel implementing projects in Sardinia (Dataenergia, 2016). Terna's actions show that there is compatibility between storage and grid. At high voltage level the grid itself – especially when it is both large and dense – works like an EE system of accumulation. The intervention at low and medium tension is more complex: smaller storage systems are less efficient. Furthermore, the separation (or unbundling) of high tension from lower tension grids imposes inter-organisational agreements and requires the regulation of exchanges. It is clear that Enel and Terna have some rivalry even if the law clearly separates their fields of action. This race is particularly evident in the storage of energy, for which there is a legal dispute as to whether storage can be considered a 'production' of energy (TSOs cannot produce energy according to an unbundling framework).

In the search for accelerators of energy transition in Sardinia, a second body is the Autonomous Region. In 2015 it passed the regional energy plan, which lists the following crucial goals:

- 50% reduction of 1990 CO2 emissions by 2030; - The intermediate source to be natural gas, whose grid on the island is now almost absent; - 3 TWh growth of EE production from RES by 2030 in comparison with 2013 values; - Identification of energy districts where the self-instantaneous consumption must be at least 50%.

Three comments can be made here: 1) a consistent aspect of transition remains with fossil fuel sources, even if natural gas has a lower environmental impact than oil or coal; 2) RES production is forecast to almost double in about 15 years; 3) mass storage of energy is frequently mentioned but its specific contribution has not been calculated, i.e. included in the targets of semi-self-sufficient districts. In general terms, the plan is ambitious and defines more demanding goals than those established by the EU. However, three years after its approval, some signals are incoherent with the path envisaged in the plan.

Through its Assessorato (Ministry) of Industry, which is also responsible for energy, the region has approved the construction of a new cogeneration plant fuelled with coal in Portovesme (Sulcis, south-west Sardinia), inside an industrial compound for the production of aluminium (Regione Autonoma della Sardegna, 2014).

In 2017 through its President, the region has stopped the authorization to build two Concentrating Solar Power (CSP) plants, affecting large surfaces in the rural municipalities of Gonnosfanadiga-Guspini and Villasor-Decimoputzu, both in southern Sardinia (Regione Autonoma della Sardegna, 2017a). Also the majors' association manifests opposition to the CSP projects (La Provincia del Sulcis Inglesiente, 2017). The negative political position is motivated by farmland occupation (approximately 250 ha each), landscape disfigurement, local population discontent, priority for much smaller plants and distributed generation.[5]

The region has approved two sources of funds for smart grids: one in two villages (Benetutti and Berchidda), in which the low tension grid is owned by local municipalities (about €1,750,000 each) (Regione Autonoma della Sardegna, 2016), the other a bid of €3.9 million for small local energy systems (self-production-storage and smart grid, maximum €150,000 for each project) to be realised by municipalities (Regione Autonoma della Sardegna, 2017b).

The regional government of Sardinia is cleverly showing that a coal plant can be compatible with the final targets of the energy plan, and that opposition to CSP is in the name of a decentralised model. According to a political economy approach, it emerges that the old industry lobby of iron (in this case aluminium) and coal remains strong, in large part because it has the support of trade unions in a region that consistently faces issues of unemployment. The CSP industry is very small, new, and probably isolated from the main Italian employers' association, Confindustria. Moreover, the cluster of companies that projected CSP in the island did not consider the typical opposition to giant plants, regardless of who promotes them and where they are placed.

Furthermore, the region has not internal financial and fiscal means to stimulate a large-scale conversion to green energy. FITs were established by the national government and their burden was distributed on all the EE fees. Without similar incentives it is likely that the ambitious goals of the regional energy plan will not be achieved by 2030. Finally, the uncertainty of the storage policy is evident: a) opposition to CSP plants which are also daily storage systems; b) the funded experiments of rural smart communities do not envisage any storage system; c) the region is not going to plan any incentives for small storage appliances in private buildings, even though it is possible (another region, Lombardy, did).

The third possible accelerator beyond national and regional governments should be *civil society*, shaped primarily by small businesses and non-profit organisations. We know that it has played an important energy transition role in some countries, although less so in Italy (Magnani and Osti, 2016). The expectation is that Sardinia's civil society plays an even minor role because of local people's limited independence from public subsidies and jobs

[3] SA.CO.I. (Sardegna-Corsica-Italia) is the historical high tension connection in direct current (HVDC) through which electricity is exchanged with the Italian peninsula and Corsica (France). It started in 1966 and has a capacity of 300 MW.

[4] Enel is former public monopolist of the national electric system. Despite unbundling and partial privatization, it keeps most part of low voltage Italian grids through its controlled company e-Distribuzione.

[5] There is a CSP project combined with a biomass power plant in Oristano, in the central part of Sardinia. The estimated total energy produced is 45 GWh/year; the plants and the facilities will cover 48 Ha of farmland (Giunta Regionale, 2016). The project has been approved by the regional government and environmental association Legambiente, but it faces opposition from Oristano's municipality and other associations.

created by mainland companies. The example comes from industrialisation, which mostly arrived on the island with external public and private capital invested in petrochemical poles (Piga, 2012 p. 292). Such an industrial path produced 'dependence' on national and world cycles, frequent crises and restructuration, and low stimuli to local enterprises (Sanna, 2015). With these beginnings and low autonomy, the Sardinian civil society is inevitably undermined.

On the fringes of Sardinian civil society is a movement for independence from the Italian state. It seems to offer superior opportunities to interpret and represent islanders' attitudes towards environmental and energy issues. It has political and cultural reasons, a combination of claims for autonomy and equity, and discrete electoral success (Pala, 2015; Sorge, 2015). At the same time, it has frequently been divided in minor groups (secessions) and unable to fully understand the interdependence of economies and identities in between the Island and the 'Continent'.

In spite of this push for greater autonomy, Sardinian civil society's commitment to energy transition appears weak and fully based on opposition. On the island, energy cooperatives are absent, while those coming from the mainland have experienced great difficulty in installing wind turbines or PV panels. In particular, wind farms were created thanks to valuable external capital and generated some financial scandals. These have helped instigate a poor image of RES amongst island society. However, Sardinia cannot be framed as a simple case of new colonisation as political economy (and autonomist rhetoric) may imply. The picture is more complex because of numerous interactive scenarios (games).

2.4. Three energy games on the island

At least three games are being played on the island. According to our framework, playing an energy game means to make it public knowledge, focused on a clear stake connected to local values (token), and reversible, i.e. giving actors opportunities to repeat the game without losing their entire stake.

The first game is between fossil fuels and RES. The match is between the Region Sardegna Government, which desires to extend natural gas grid to the entire island (we call it *methanisation*), and the national RES industry, a pressure group in the search for its own strategy. Both players are weak. The region needs large-scale capital to build the gas pipeline and/or the terminals for liquefied gas ships. Only big multinational companies or the national government can make such an investment. It is not clear 'who' will be the investor. The RES industry lacks a specialisation so strong that it can become competitive in global and local markets. CSP technology would be effective but the lobbying and moral persuasion of project promoters in Sardinia appears very feeble.

In the conflict over CSP (see long and harsh debate in Gruppo d'Intervento Giuridico, 2016), two structures of justification emerge: "one refers to universalisation and universal rights, while the other is geared towards what makes sense in a particular culture with its specific mores and morals" (Thévenot, 2015, p. 1). Solar energy is clean and a right of each human being, while the opponents to CSP seek respect for their specific landscapes. The former justification has proven too abstract for islanders, who suspect that the CSP plants were real scale examples to be shown to international investors. The latter justification (specific mores and morals) is overloaded in Sardinia, causing domino effect mobilisation. In fact, the group opposing CSP is large and diverse, comprising not only the aforementioned regional administration, but also farmers' organisations, majors, and autonomist and environmental groups. In contrast, the favourable front was very small, being formed of single experts linked to the specific CSP package or representative of 'national' environmental associations. Through single exponents, the main Italian environmental association (Legambiente) expressed considerable criticism of the coalition opposing the two CSP projects, while the representatives of the same association in Sardinia were aligned with opponents (Berlen, 2016).

The tokens are *farmland* and *landscape*. Farming is considered a typical, rooted and poorly treated activity in Sardinia. Its recovery is seen as a useful and desirable goal, and a potentially valuable source of identity construction. CSP plants would have occupied good land. However, the pro-CSP groups opposed the idealisation of farming, arguing that agriculture and livestock rearing have *already* destroyed the Sardinian environment with heavy mechanical and chemical agro-practices.

The front against CSP assumed the form of a social movement (Cugusi, 2017), while those favourable remained 'single voices without a father', that is to say without a token of the same power. The regional government has not been an arbitrator but has instead picked a side. All of the adversarial players came from mainland and made some important errors, presenting the power plant projects on too great a scale and underestimating local authorities' opposition. Thus, the match has been misguided since the beginning. Even the conditions for the game were not assured: reciprocal recognition is very rare in a context in which the adversary is an enemy. A field where teams can play was lacking: the CSP projects received no public debate and provided no opportunities to make observations. Finally, a credible arbitrator such as a third, neutral party was lacking as well: neither the region nor the energy authority enjoys the prerequisite prestige or competence.

The second game concerns the choice of technological packages for energy transition. The opportunity to compare them requires the same conditions as previously mentioned: the entitlement of actors and technologies, a special place to play the game, and an impartial evaluator. Methane use has reached great maturity, and as regards piping and burning technologies, Italian industry seems to enjoy an advanced position. Sardinia lacks expertise in this regard, hence no game at all, rather simple acceptance of an external technological package. A more subtle and contested issue is that of technologies linked to the smart grid and storage. For what concerns the smart grid software, Sardinia seems able to participate in the game. Sardegna Ricerche – the regional agency for Research & Technological Development – is fully involved in the experiment in at least one of the envisaged smart community (Benetutti). In the other municipality selected for the experiment (Berchidda), another form of software will be used and a private company (not the regional agency) seems involved. Apparent then is light but not explicit competition between the two municipalities and, behind them, two different technological packages. Lay people from both communities know almost nothing of the practical aspects of smart grid. Despite the knowledge deficit, the race between the two municipalities has started and, according to our framework, it should produce some advancements in energy transition.

The match of storage technologies has never started. We know that TSO Terna is experimenting with several chemical modalities of storage, while Enel, the former public monopolist, has not yet invested in storage in Sardinia. Enel is acquiring foreign companies specialised in smart grid software and no-chemical storage systems (Stout, 2017; Spector, 2017b). It is probable that Enel has not chosen Sardinia for its experiments regarding storage and smart grid, in spite of its numerous wind farms, operated via its company Enel Green Power. This weak attention to storage systems in Sardinia is at odds with investment in other Mediterranean islands.[6]

[6] Enel, through its Spanish-controlled company Endesa, has completed large storage installations in the Canary Islands (Enel, 2016).

Table 3
Energy transition of Sardinia according to the criteria of game/play perspective.

ENERGY GAMES	Fossil vs renewable sources	On smart grids and EES technologies	Independence vs Interdependency
Conditions			
Recognised players	Yes, but they are weak	Only regional R&S Agency	Yes, regional parties and ecological associations
Playgrounds	Limited debate on Energy Regional Plan	Not Identified	Yes, virtual and real 'piazzas' are active
Arbitrators	No, neither national Ministries	Limited, Regional Government	No, neither supranational public bodies
Qualities			
Publicity	Limited to sectors lobbies	Limited to private and public experts	Yes
Tokens	Yes, they are farmland and landscape	Yes, it is distributed generation model	Very strong, but badly formulated, mishandled
Reversibility	Limited, energy plants are long lasting	Yes, both technologies are flexible (modularity)	SACOI and SAPEI created high EE interdependency
Future Developments	Very slow transition to RES, methanisation will never occur	Slower and limited penetration of smart grid and ESS in the cities	Further improvement of high voltage cables and same scale ESS

The third game is being played on a more symbolic field. It concerns *sovereignty*, a label frequently used in Sardinia for fighting against *military easements* (military practice-bombing range). The practice has caused great damage to the environment and has attracted protests by local movements (Codonesu, 2013). Likewise, representatives of the autonomist movement have seen RES penetration as an energy easement. The argument is mismatched because RES increases autonomy from external sources. It is true that many wind farms and large-scale PV panels were installed by external multinational companies. However, even this argument is ambivalent: surely these overseas investors were attracted by the opportunity to make an easy profit, in the process damaging land and landscapes, yet it is also true that local authorities were unable or unwilling to stop them and local people were incapable of developing a smaller-scale set of RES plants. The game on energy sovereignty is without a clear token and it lacks a shared narrative representation. Furthermore, the match is disordered because there is no arbitrator, i.e. a supranational body like the European Union, which ensures that the players know and respect the rules of the game.

It is true that numerous real and virtual places of participation exist, from websites to city *piazze* (squares), reflecting the varied repertoire of social movements. Notably, in 2011 a regional referendum on the possibility of Sardinia hosting the national nuclear waste repository attracted a high voter turnout (Rquotidiano, 2011). The first quality of game framework (publicity) was hence respected. The second (tokens) far less so: the energy sovereignty argument was mishandled and often used for achieving easy consensus (populism).

The third quality (reversibility) concerns the chances of repeating the game. The answer is forward-looking: the movement for independence will surely look for new energy arguments and the RES industry will not overlook the island's great wind and solar potential. Thus, ideological disputes over new projects will occur, with attention not only to RES plants but also probably to storage systems.

3. Results and perspectives

3.1. A Mediterranean model

Generally speaking, the Sardinia movement toward RES development and energy saving/efficiency has been slow and largely dependent on external funds both public incentives and private investments. The island broadly fits with the south European model of energy transition, which is characterized by huge investments in large scale RES without the involvement of local people, and uncertain regulation of regional authorities (Scotti and Minervini, 2017). Local civil society organisations are committed neither to the ownership of RES plants nor to the use of green energy. However, Sardinia has some particularities. The number of small roof PV panels is higher than in southern Italy. Moreover, the ability of regional authorities to guide the transition seems superior to other Southern Italy Regions. An ambitious energy plan establishing stringent short-term goals of environmental sustainability has been adopted by the Regione Autonoma della Sardegna.

The dynamism of an energy system is also revealed by the interactive capacity of the stakeholders, including the final consumers (demand side). The game metaphor has allowed to assess some qualities of the energy supply-demand dynamic. The results are summarised in the Table 3. The first result is that some energy games exist in the island; Sardinia organisations are playing; they are not passive receivers. The old monopolies and the dominance of fossil sources have been challenged. Especially RES development is aligned to European Union targets. The new players – regional agencies, RES lobby, prosumers – however, are quite weak. For them initial costs of investments on more sustainable energy devices are still too high in comparison to their incomes and revenues. With a so weak demand, the expectation of a transition driven by final consumers vanishes.

3.2. Participation

The second result concerns rules and places of participation. In the game metaphor they are conditions for playing fairly. These requirements are not fully respected in Sardinia. Especially, a third party (*arbitrator*) able to monitor the games and sanction deviant players is absent or de-legitimated. Despite the presence of a national authority and a regional Ministry of industry and energy, the local transition has been hardly regulated. The other conditions for game participation – debating places or *playgrounds* – are underdeveloped in Sardinia. Formalized mechanisms of participation have never been activated; spontaneous debates on virtual and real 'piazza' are vivid, but sporadic and without practical results. The only perceptible outcome has been a long list of observations made by citizens and associations to the regional energy plan.

3.3. Publicity

A third result concerns publicity of energy games. The three envisaged matches present different situations. In any case, low visibility prevails and the energy system seems still populated by a restricted number of actors forming what is called a *policy community* in opposition to a broad and horizontal *policy network* (Cairney, 2011). Owners of high and low voltage grids are the only actors able to affect all the energy transition. They have as well capitals to invest and a deep knowledge of the energy system. The match on island energy sovereignty has more visibility, but as

above highlighted, the stakes and the technical solutions are not so clear. In terms of supply and demand, the unbalance in favour of former is evident.

3.4. Symbols

The visibility introduces the fourth result, which concerns so-called tokens. Energy transition has become an important symbolic value only for a minority of islanders. The majority has not identified RES development and energy saving as an instrument to enact the typical goals of social redemption and political independence. Thus, motivation for installing PV panels or ESS-smart grid devices is merely economic. In a situation of low incomes and in the absence of public subsidies the adoption of energy innovations does not happen. Evidently, narratives of energy transition is not consistent with aspirations and beliefs of Sardinia people (Malone et al., 2017). For example, the great CSP plant recall local people old-dated processes of 'colonisation' by mainland powers. As a result, the project is rejected.

3.5. Reversibility

The last result concerns reversibility. The three games have not the same easily reversible or repeatable situation. The confrontation between fossil sources and RES reflects the conflict between great energy plants and distributed generation. Nevertheless, also RES have great plants that creates a 'one shoot game'. A heavy energy infrastructure has to work for a long time for returning the investments; its environmental impact is generally heavy and long term, too. The low degree of reversibility exacerbates the opposition, in this way obstructing the chance to create a serial game, in which the losers can win a successive match. It is clear that players proposing huge plants have not considered the general negative attitudes toward big and stable energy infrastructures (Devine-Wright, 2011).

The other two Sardinia energy games are more reversible (Table 3), but for different reasons. ESS and smart grid technologies are modular and adaptable to every territorial scale. This offers chance of investment for all players of the energy chain, provided that they have cash or access to credit. That is the problem for Sardinia consumers who are on average poorer than Italians. Thus, the progress of these technologies is highly dependent on public incentives.

The game on energy independency or interdependency is reversible thanks to two submarine cables ensuring a flexible trade of power with mainland. Combined with large scale ESS, they could give to Sardinia the chance to play on electric continental markets from a stronger position. This scenario, however, implies further investments on storage systems and possibly on a third submarine cable. The game is open because big national players like ENEL and TERNA push for increasing electrification, while the Regione Sardinia planned for full island methanisation. In this context, social movements appear confused on which direction the energy transition should take.

3.6. Perspectives of cleaner production

Some possible future outcomes of the Sardinia energy games regard the chances of cleaner production and consumption. The first game will probably become a trench warfare: a very long confrontation without a neat victory by one single player. Full methanisation of Sardinia is a difficult target; on the opposite front, a great and rapid progress of RES is unlikely. Sardinia will not be a champion of renewables neither a self-sufficient island, despite its abundance of sun and wind. Games on energy saving technologies will depend on public funds and on chances to win European Union bids for innovative projects. Both possibilities are unpredictable.

Italian Government maintained in these years only generous tax deduction for improvements of building energy performance. It is an insufficient measure for a massive introduction of combined PV panels and ESS. Moreover, this kind of incentive is useless in regions like Sardinia where most people have low or no income. Incremental progresses in the electric subsystem both of the grid and of small-medium scale ESS and generation plants are more likely. High voltage grid modernisation, smaller CSP plants and wind micro-turbines will not face strong opposition. It remains the problem whether investors will consider them convenient and whether the few Sardinia money savers will decide to increase (electric) energy interdependency with their neighbours. This is a matter dependent not only on legal frameworks and technical devices but also on attitudes to cooperate with other people.

Acknowledgements

The research is funded with the 2015 FRA Fund of Trieste University. The research in Sardinia has been done with the partnership of Daniela Patrucco, Vice-president of Cooperative Retenergie, Racconigi, Italy.

References

Agarwala, Y., 2017. 100% Renewable Energy Transition in Small Island Developing States (SIDS). A quick Scan backcast for 2 islands in the Caribbean – Curacao and Grenada. Faculty of Electrical Engineering, Mathematics and Computer Science, Delft University of Technology.

Amini, M.H., Boroojeni, K.G., Iyengar, S.S., Blaabjerg, F., Pardalos, P.M., Madni, A.M., 2018. A panorama of future interdependent networks: From intelligent infrastructures to smart cities. In: Amini, M.H., Boroojeni, K.G., Iyengar, S.S., Pardalos, P.M., Blaabjerg, F., Madni, A.M. (Eds.), Sustainable Interdependent Networks: From Theory to Application. Springer, Cham, pp. 1–10.

Beermann, J., Tews, K., 2017. Decentralised laboratories in the German energy transition. Why local renewable energy initiatives must reinvent themselves. J. Clean. Prod. 169, 125–134. ISSN 0959-6526. https://doi.org/10.1016/j.jclepro.2016.08.130.

Berlen, L., 2016. Il solare termodinamico in Sardegna non s'ha da fare? Qualenergia, 13 September. www.qualenergia.it/articoli/20160913-il-solare-termodinamico-sardegna-non-s-ha-da-fare. (Accessed 9 February 2018).

Bouzarovski, S., Tirado Herrero, S., 2017. The energy divide: integrating energy transitions, regional inequalities and poverty trends in the European Union. Eur. Urban Reg. Stud. 24 (1), 69–86.

Bueno, C., Carta, J.A., 2006. Wind powered pumped hydro storage systems, a means of increasing the penetration of renewable energy in the Canary Islands. Renew. Sustain. Energy Rev. 10, 312–340.

Bunker, K., Hawley, K., Morris, J., 2015. Renewable microgrids: profiles from islands and remote communities across the globe. Rocky Mountain Institute, Boulder.

Cairney, P., 2011. Understanding Public Policy: Theories and Issues. Palgrave Macmillan, New York.

Chapman, A.J., Itaoka, K., 2017. Energy transition to a future low-carbon energy society in Japan's liberalizing electricity market: precedents, policies and factors of successful transition. Renew. Sustain. Energy Rev. 81, 2019–2027. https://doi.org/10.1016/j.rser.2017.06.011.

Chen, F., Duic, N., Alves, L.M., da Graça Carvalho, M., 2007. Renew-islands—renewable energy solutions for islands. Renew. Sustain. Energy Rev. 11, 1888–1902.

Ciriminna, R., Pagliaro, M., Meneguzzo, F., Pecoraino, M., 2016. Solar energy for Sicily's remote islands: on the route from fossil to renewable energy. Int. J. Sustai. Built Environ. 5 (1), 132–140.

Codonesu, F., 2013. Servitù militari modello di sviluppo e sovranità in Sardegna. CUEC, Cagliari.

Cugusi, M.G., 2017. Land Grabbing in Sardinia: the Case of Renewable Energy. Perspectives on Environment, Social Justice, and the Media in the Age of the Anthropocene. University of Sassari, Sardinia, pp. 15–17. June.

Dataenergia, 2016. Facciamo il punto sull'installazione di accumuli a batterie di grande scala in Italia (aggiornamento maggio 2016), p. 22. May. dataenergia.altervista.org/portale/?q=installazione_accumuli_batterie_grande_scala_italia#I_progetti_di_Enel. (Accessed 31 July 2017).

Devine-Wright, P., 2011. Public engagement with large-scale renewable energy technologies: breaking the cycle of NIMBYism. WIREs Climate Change 2 (1), 19–26.

Dornan, M., 2015. Renewable energy development in small island developing states of the Pacific. Resources 4 (3), 490–506.

Dovì, V.G., Friedler, F., Huisingh, D., Klemes, J.J., 2009. Cleaner energy for sustainable

future. J. Clean. Prod. 17 (10), 889–895.
ENEA, 2015. Rapporto Annuale Sull'Efficienza Energetica 2015. Rome.
Enel, 2016. STORE Project: Islands Systems Storage Support, 16 February. http://bit.ly/2vztQCT. (Accessed 5 August 2017).
Erker, S., Stangl, R., Stoeglehner, G., 2017. Resilience in the light of energy crises – Part I: a framework to conceptualise regional energy resilience. J. Clean. Prod. 164, 420–433.
Eurostat, 2017. Europe 2020 Indicators - Climate Change and Energy. http://ec.europa.eu/eurostat/statistics-explained/index.php/Europe_2020_indicators_-_climate_change_and_energy. (Accessed 26 January 2018).
Evans, P.B., 1989. Predatory, developmental, and other apparatuses: a comparative political economy perspective on the Third World state. Socio. Forum 4 (4), 561–587.
Fink, E., 2008. L'oasi del gioco, RaffaelloCortina, Milano (origine text: 1957, Oase des Glücks. Gedanken zu einer Ontologie des Spiels).
Geels, F.W., 2010. Ontologies, socio-technical transitions (to sustainability), and the multi-level perspective. Res. Policy 39, 495–510.
Geels, F.W., 2011. The multi-level perspective on sustainability transitions: responses to seven criticisms. Environ. Innov. Soc. Trans. 1, 24–40.
Giunta Regionale, 2016. Impianto solare ibrido termodinamico. Comune di Oristano, località San Quirico – Tanca 'e Su Presidente. Proponente Società San Quirico – Solar Power S.r.l. Procedura di V.I.A. D.Lgs. n.152/2006. Deliberazione n. 63/51, 25 November, Cagliari.
González, N.C, 2017. New environmental policy instruments in the tradeoff between energy and environmental sectors in developing countries. Rivista Italiana di Politiche Pubbliche 3, 333–354.
Gruppo d'Intervento Giuridico, 2016. Il progetto di centrale solare termodinamica di Decimoputzu Villasor è un caso emblematico: ora la Giunta Pigliaru dimostri di rappresentare la Sardegna, 1 September. https://gruppodinterventogiuridico web.com/2016/09/01/il-progetto-di-centrale-solare-termodinamica-di-decimoputzu-villasor-e-un-caso-emblematico-ora-la-giunta-pigliaru-dimostri-di-rappresentare-la-sardegna/. (Accessed 25 June 2017).
Gse, 2015. Rapporto Statistico 2014. Solare fotovoltaico, Rome.
Gse, 2017. Rapporto Statistico. Energia da fonti rinnovabili in Italia. Rome, March.
Gupta, K., 2017. Are oil and gas firms more likely to engage in unethical practices than other firms? Energy Policy 100, 101–112.
Hartley, J., 2004. Case study research. In: Cassell, Catherine, Symon, Gillian (Eds.), Essential Guide to Qualitative Methods in Organizational Research. Sage, London, pp. 323–333.
Huizinga, J., 2002. Homo ludens. Einaudi, Torino.
Kaldellis, J.K., Zafirakis, D., Kavadias, K., 2009. Techno-economic comparison of energy storage systems for island autonomous electrical networks. Renew. Sustain. Energy Rev. 13, 378–392.
Karunathilake, H., Perera, P., Ruparathna, R., Hewage, K., Sadiq, R., 2018. Renewable energy integration into community energy systems: a case study of new urban residential development. J. Clean. Prod. 173, 292–307.
Koster, A.M., Anderies, J.M., 2013. Institutional factors that determine energy transitions: a comparative case study approach. In: Michalena, E., Hills, J. (Eds.), Renewable Energy Governance. Lecture Notes in Energy, vol. 23. Springer, London.
La Provincia del Sulcis Inglesiente, 2017. Il presidente dell'Anci Sardegna ha inviato una lettera al presidente del Consiglio sulla procedura di VIA dei progetti di Impianti Solari termodinamici "Gonnosfanadiga" e "Flumini Mannu", 15 July, on line journal. http://www.laprovinciadelsulcisiglesiente.com/wordpress.
Magnani, N., Osti, G., 2016. Does civil society matter? Challenges and strategies of grassroots initiatives in Italy's energy transition. Energy Res. Social Sci. 13, 148–157.
Malone, E., Hultman, N.E., Anderson, K.L., Romero, V., 2017. Stories about ourselves: how national narratives influence the diffusion of large-scale energy technologies. Energy Res. Social Sci. 31, 70–76.
Mitchell, C., 2008. The Political Economy of Sustainable Energy. Palgrave-Macmillan, Basingstoke.
Oostindie, G., 2006. Dependence and autonomy in sub-national island jurisdictions: the case of the kingdom of The Netherlands. Commonwealth J. Int. Aff. 95 (386), 609–626.
Osti, G., 2016a. Storage and Scarcity. New Practices for Food, Energy and Water. Routledge, London and New York.
Osti, G., 2016b. Renewables, energy saving and welfare in Italian fragile rural areas. Sociol. Polit. Soc. 19 (3), 102–118.
Owen-Smith, J., Powell, W.W., 2008. Networks and institutions. In: Greenwood, R., Oliver, C., Suddaby, R., Sahlin, K. (Eds.), The SAGE Handbook of Organizational Institutionalism. Sage, London, pp. 594–621.
Pala, C., 2015. Sardinia. The Wiley Blackwell Encyclopedia of Race, Ethnicity, and Nationalism. John Wiley & Sons, pp. 1–3. Wiley on line Library.
Pellerin-Carlin, T., Vinois, J.-A., Rubio, E., Fernandes, S., 2017. Making the Energy Transition a European Success. Tackling the Democratic, Innovation, Financing and Social Challenges of the Energy Union. Jacques Delors Institute, Paris.
Piga, M.-L., 2012. La prospettiva della solidarietà nello sviluppo durabile. In: Deriu, R. (Ed.), Sviluppo e Saperi nel Mediterraneo. FrancoAngeli, Milano.
Podobnik, B., 2006. Global energy shifts. In: Fostering Sustainability in a Turbulent Age. Temple University Press, Philadelphia.
Redazione Casteddu Online, 2016. Pigliaru: la Sardegna come Pellworm, autosufficiente nell'energia. http://www.casteddуonline.it/pigliaru-la-sardegna-come-pellworm-autosufficiente-nellenergia/. (Accessed 21 July 2017).
Regione Autonoma della Sardegna, 2014. Infrastrutturazione energetica dell'area industriale di Portovesme, 23 September. http://www.regione.sardegna.it/index.php?xsl=510&s=263712&v=2&c=12505&t=1&tb=12487&st=17. (Accessed 1 August 2017).
Regione Autonoma della Sardegna, 2015. Piano energetico ed ambientale della Regione Sardegna 2015-2030. In: Rapporto ambientale. Sintesi non tecnica. Assessorato dell'Industria, Cagliari.
Regione Autonoma della Sardegna, 2016. Industria, energia: per Benetutti e Berchidda un futuro da Smart community. In: 8 November. http://www.regione.sardegna.it/j/v/25?s=321845&v=2&c=3697&t=1. (Accessed 1 August 2017).
Regione Autonoma della Sardegna, 2017a. Solare termodinamico, Pigliaru scrive a Gentiloni contro realizzazione impianti Gonnosfanadiga e Flumini Mannu, 15 March. http://www.regione.sardegna.it/j/v/25?s=332434&v=2&c=125&t=1. (Accessed 1 August 2017).
Regione Autonoma della Sardegna, 2017b. Comuni, azioni per lo sviluppo di progetti sperimentali di reti, 9 March 2017. http://www.regione.sardegna.it/j/v/13?s=331919&v=2&c=3&t=1. (Accessed 25 June 2017).
Renzi, S., 2017. La Corrente Che Tira – Basilicata, Calabria, Sicilia, Sardegna, 13 June. http://astrolabio.amicidellaterra.it/node/1314. (Accessed 18 June 2017).
Rquotidiano, 2011. Referendum Sardegna, Oltre Il 97% Dice No Al Nucleare. Un Segnale Al Governo, IlFattoQuotidiano.it, 16 May. https://www.ilfattoquotidiano.it/2011/05/16/il-97-per-cento-dei-sardi-contro-il-nuclear-ebrcappellacci-dal-referendum-segnale-forte/111576/. (Accessed 9 February 2018).
Sanna, F., 2015. Passaggio a Sud-Ovest. Itinerario di miniera nella Sardegna sud-occidentale. Diacronie 22 (2). https://doi.org/10.4000/diacronie.2072. http://diacronie.revues.org/2072.
Santana Sarmiento, F., Álamo Vera, F.R., De Saá Pérez, P., 2017. The competitive value of territorial resources for photovoltaic energy on the island of Gran Canaria. Island Stud. J. 12 (1), 223–242.
Scotti, I., Minervini, D., 2017. Performative connections: translating sustainable energy transition by local communities. Innovat. Eur. J. Soc. Sci. Res. 30 (3), 350–364.
Sorge, A., 2015. Legacies of Violence: History, Society, and the State in Sardinia. University of Toronto Press, Toronto.
Spector, J., 2017a. 100% Renewables Plan Has 'significant Shortcomings,' Say Climate and Energy Experts. Greentech Media, 19 June. www.greentechmedia.com/articles/read/100-percent-renewables-plan-has-significant-shortcomings-say-experts. (Accessed 4 August 2017).
Spector, J., 2017b. Italian utility Enel Acquires Energy Storage Specialist Demand Energy. Greentech Media, 11 January. www.greentechmedia.com/articles/read/italian-utility-enel-acquires-energy-storage-specialist-demand-energy. (Accessed 4 August 2017).
Stout, M., 2017. Amber Kinetics and Global Energy Giant Enel S.p.a. Announce Agreement to Assess Innovative Flywheel Storage Technology. Amber Kinetics, 6 July. http://amberkinetics.com/amber-kinetics-and-global-energy-giant-enel-s-p-a-announce-agreement-to-assess-innovative-flywheel-storage-technology/. (Accessed 1 August 2017).
Terna, 2016. Tecnologia e soluzioni hi-tech. In: Sardegna rete elettrica da primato mondiale. Press Release, Rome, 17 November.
Thévenot, L., 2015. Making commonality in the plural on the basis of binding engagements. In: Dumouchel, P., Gotoh, R. (Eds.), Social Bonds as Freedom: Revising the Dichotomy of the Universal and the Particular. Berghahn, Oxford and New York, pp. 82–108.
Trigilia, C., 2002. Economic Sociology: State, Market, and Society in Modern Capitalism. Blackwell, Oxford.
Turcu, C., Rydin, Y., Pilkey, B., 2014. Energy in the locality: a case for local understanding and action. Local Environ. 19 (5), 469–478.
Voß, J.-P., Smith, A., Grin, J., 2009. Designing long-term policy: rethinking transition management. Pol. Sci. 42 (4), 275–302.
Walker, G., Cass, N., 2007. Carbon reduction, 'the public' and renewable energy: engaging with socio-technical configurations. Area 39 (4), 458–469.
Winnicott, D.W., 1971. Playing and Reality. Tavistock Publication, London.
Wolf, F., Surroop, D., Singh, A., Leal, W., 2016. Energy access and security strategies in small island developing states. Energy Policy 98, 663–673.
Zainal, Z., 2007. Case Study as a Research Method, Jurnal Kemanusiaan bil.9.