Community Energy Enterprises in a polycentric society: new devices for local energy system

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New technologies for "local energy systems" have recently reached a degree of maturity that now allows for significant innovations and investments in community-based initiatives. As such, they could have a critical role in totally new polycentric development processes. While the issue of distributed energy is widely discussed in technological terms, a more articulate connection between distributed energy productions and local initiatives still needs to be elaborated and put into practice. The main objective of this paper is therefore to verify how the availability and advancement of certain current technologies – along with the potential of new forms of community organisations – can solve some of the economic and environmental problems that are becoming an increasingly critical and inexorable challenge in today's world. The principal issue here is that the crucial obstacle to innovating the utilities supplying statutory services to local communities today remains basically our outdated legislation and regulation. In many countries, the legal setup for the entire supply system was actually devised to secure and perpetuate the interests of the centralised, statutory energy sectors. This analysis therefore suggests ways in which certain elements of our legal framework might be revised and reformulated so as to allow greater leeway for the proliferation of bottom-up initiatives in energy production.

Keywords: local energy systems, community enterprises, community technology.

1. Introduction

An energy system is an "energy chain" that comprises energy production, conversion, transmission, distribution and consumption (Alanne and Saari, 2006).
The technologies currently available for creating "local energy systems" (e.g., small devices to product electricity on-site, two-way smart grids and micro-grids, etc.) have reached a promising level of advancement, and these new system are now in a good position to be integrated with renewable energy sources, and for reducing supply costs, streamlining consumption, creating new production chains, increasing local employment, and not least the empowerment of the local communities.
Any discussion of these new systems inevitably pivots on how they compare with the large energy systems, namely the traditional centralised models of energy production, and on the viability of local energy systems as an alternative in terms of efficiency and sustainability.
At present the debate on local energy production hinges mainly on questions of technology and engineering; at most, some reflections on economy are thrown in for good measure. What we believe is essential is to cast the net wider and include the organisational, social, and ethical-political issues involved (until now largely ignored: Alanne and Saari, 2006; Ribeiro et al., 2012). As Nele Friedrichsen et al. (2014, p.264) observe, "*the institutional set-up of the smart system is still uncertain*". The crucial issue here is that in a distributed energy system "distribution" refers not only to energy generation units, but also to ownership, decision-making and responsibility as regards energy supply (Alanne and Saari, 2006). In short, distributed energy means more than merely situating smaller energy units close to consumers.

2. Available technological for local energy systems

Local energy systems have now become a workable reality thanks to new technologies that can guarantee local energy production and distribution, along with computerised systems for managing local demand and consumption, which include such vital devices known as the "smart grid", along with their parallels such as "micro-grids" (functioning in both on and off-grid modes), and the other experimental systems such as on-site utilities and user coalitions (Mendes et al, 2011; Chicco e Mancarella, 2009; Hiremath et al, 2007).
More specifically, the relevant technologies can be grouped into three main categories, as follows: first, technologies related to the production and utilisation of energy – namely, those that enable the on-site

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production of the energy needed by the local system, and for ensuring that consumption is efficient; second, the technologies for the distribution and proper flow within local grids; third, management technologies that enable the remote control of the assets of production, distribution, storage, and consumption of energy.

2.1. Production, storage, and usage of energy

As far as the local production plants are concerned, the available technologies are based on four different types of renewable source: photovoltaic/solar thermal, wind farm, small-scale hydropower, and geothermal; but to some degree they also rely today on traditional sources, such as the use of heat pumps or co-generation/tri-generation systems.

Among the technologies in this first category are also those relating to accumulators and devices (electrochemical and others) for storing electrical and thermal energy; logically, these are critical for off-grid units, namely special systems that can run independently from the national power grid.

Similarly, the technologies affecting the end-use of energy can contribute to improving the local networks, such as more efficient lighting and heating, building automation, and the use of smart appliances.

A fair quota of technologies for energy production and consumption have achieved a high level of effectiveness and sophistication (Fig. 2), and boast an increasingly valid cost-efficiency ratio. The only area still lacking at present is storage technology, though a recent report published by UBS (2014) – in tandem with Tesla and Umicore – shows a vast market potential of storage technologies in the next twenty years, which will see an up to 50% reduction in energy storage costs by the year 2020 (Fig. 1).

2.2. Distribution of energy

By "technologies for energy flow" we mean local infrastructure for optimising the transfer of energy from the power units to the points of consumption.
This area of technology can be divided into two types.
The first is the physical distribution system itself, either for electrical energy (electricity network) or for thermal energy (remote heating network), which consists of pipes and/or pipelines created to connect the energy production plants to the storage depots, the end-users, and on occasion also the national grid (Rezaie and Rosen, 2012).
The second is the communications network or information exchange systems linking the various "nodes" of production and consumption. This virtual grid facilitates the exchange of data via cables (increasingly optic) or wireless data transmission (radio waves, or infrared). This technology was set up to ensure the efficiency of the physical network and deploys sophisticated smart-metering devices to maximise production/consumption ratios (Feng et al., 2013).

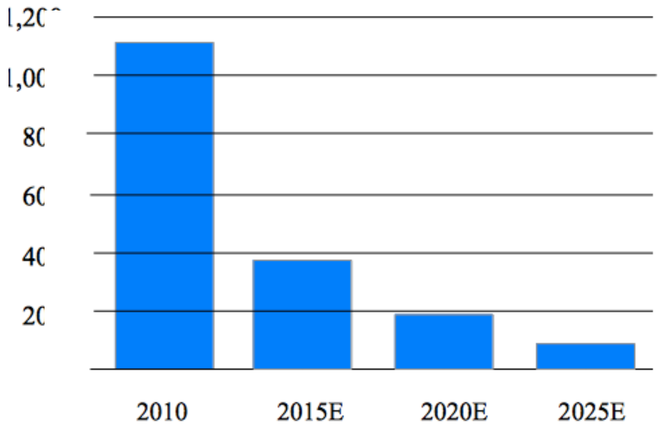

Figure 1. Graph of cost of energy saved on storage devices (€/kWh); re-elaborated by the authors from data estimated by Tesla, Umicore, and UBS (UBS, 2014).

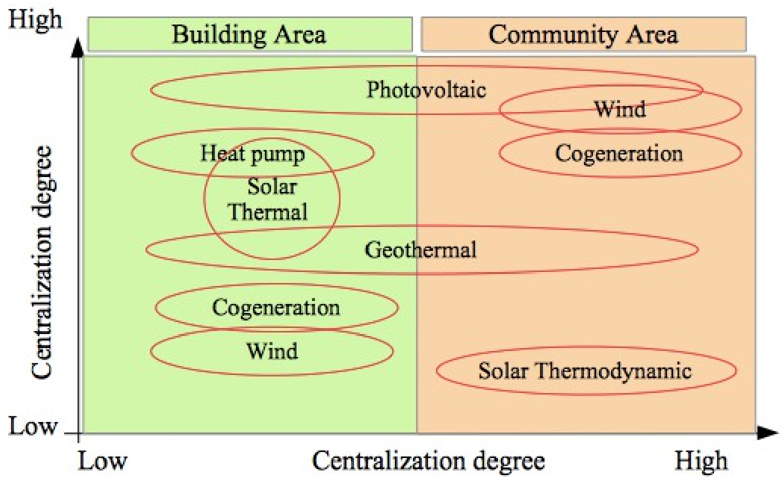

Figure 2. Degree of technological advancement and centralisation from building to system (from left to right) in energy production technology; re-elaborated by author from an evaluation done by the Energy and Strategy Group and the School of Management of the Politecnico di Milano (ESG, 2014)

2.3. Management, control, and monitoring of energy flow

The technologies involved in the control, management and monitoring of energy flow consist of two systems in particular.

First we have the software systems that can forecast energy consumption patterns and those for the production of plants powered by renewable sources; these systems include cloud computing energy efficiency (Berl et al.; 2010). Such predictive systems make it possible to optimise consumption and ensure the efficiency of the local energy grid.

Second come the hardware systems backing up the assets of production, storage, and consumption. These devices are the physical side of energy management (computer, sensors, meters, switches) that function at the local unit or network scale, automatically regulating the network flow to ensure the maximum efficiency in response to the fluctuating consumption quotas.

3. A potential system of decentralised energy units: aspects of infrastructure and organisation

The world's major energy networks continue to provide the backbone for most of human activity, and are hence essential for the proper functioning of today's societies. Thanks to them we have linkage between producers and consumers, the transmission of energy between different regions and states, energy for our offices and homes, and heating and air-conditioning according to the changing climatic conditions.
According to a recent study (Dobs et al., 2013), the value of a country's overall infrastructure stock (including energy, but also roads and waterways) on average amounts to 70% of its GDP – that is, an enormous amount of capital. Given such a massive employment of physical and financial assets, at first sight any alteration to this setup would seem impracticable.
When we think of the energy infrastructure, we invariably think primarily of the physical infrastructures needed for energy production, transformation, transmission, distribution, and storage. The current setup for electricity production is principally generated by large power plants, which are usually located at a considerable distance from the end-users, who receive it via long and complex networks of power lines. In Italy the current power grid is composed of 63,500 kilometres of cables (www.terna.it).
A possible alternative scenario centred on local energy systems would entail the creation of numerous smaller, modular plants located closer to the places where that energy is actually being consumed. At present, such a setup could come about by combining traditional power plants burning fossil fuels with other renewable sources. In future that energy production could rely entirely on the latter sources (photovoltaic, solar thermal, wind farm, small-scale, hydropower, geothermal). Basically, this local redistribution is the

only arrangement that would enable a extensive network of renewable energy sources to function (Scheer, 2010; Lowi & MacCallum, 2014).

If we embrace this idea of local energy systems, we need also to think about what kind of organisations would be appointed to manage these new initiatives. The concept opens up a whole new gamut of opportunities in collective energy production and management. The nodes of this new polycentric system of energy production will not be the individual homes, stores, or industries (as is often considered, also in terms of new legislative measures), but new forms of "intentional communities", and "voluntary communities" (Brunetta and Moroni, 2011).

We will adopt the expression "Community Energy Enterprises" to indicate this particular type of collective management unit (voluntary, self-regulating and self-financing); clearly, such units could easily form coalitions to create a wider grid of sorts.

To this end, the production of on-site energy would not only benefit domestic appliances and so forth (heating, lighting, etc.), but also could be used for recharging electric vehicles and the like (Newcomb, 2013).

The efficiency of a polycentric system of electricity generation of this type would be guaranteed by the introduction of the aforementioned smart grids, whereby the units are rendered interactive via smart software protocols. This contrasts with the standard type of power grid with its single source and passive distribution, and instead would involve users interactively with the grid (consumers and producers) connected to a network fed by multiple energy sources. As such, the smart network would be able to respond promptly to surges and dips in demand from the various end-users, thereby ensuring the optimal and immediate management of energy supply and demand (Butera, 2007; Dall'Ò and Galante, 2010; Enea, 2011; ESG, 2014; U.S. Department of Energy, 2014). Clearly, this smart grid does not need to pose as a public utility, nor need it be unique or universal. Such a scenario does away not only with the alleged intrinsic reasons for a "natural" monopoly of energy *production*, but also with the idea of "natural" *distribution* monopolies.

As Alvin Lowi and Wayne Crews write (2003, p.164): "*Historically ..., electric utilities never achieved natural monopoly status before the advent of the state public utility commissions that arose to regulate them*". See also Geddes (1992, p.76): in the sector of electric utilities, "state regulation was instituted not to correct private market failures and to increase social welfare, but to provide firms with a way to insulate themselves from the discipline of competition". The issue is evidenced also by Fred Foldvary (2005, p. 28): "*Electricity provision has been regarded as a natural monopoly, a utility with a high fixed cost and low marginal cost. ... Historical studies have shown that governments have helped to create a monopoly situation – there may not be a natural monopoly*".

4. Polycentric energy systems: the foreseeable implications

The advantages of a polycentric system composed of multiple local energy systems are twofold: it would have positive implications both in general terms (i.e., systemic benefits) and for the end-users (i.e., specific benefits).[3] Here we will look at six different forms of positive side-effects generated by a polycentric energy system.

4.1. Reduction in power transmission and distribution losses, and recovery of residual heat

At present, local energy production could turn out more expensive, owing largely to the reduced size of these distributed energy production plants. This greater outlay would be immediately offset however by the lack of the notorious energy losses whenever electricity is transmitted over long distances. In Italy these electric power transmission and distribution losses amounted to 6.2% of the energy on the national grid in 2007, 6% in 2008 (www.terna.it) and 7% in 2011 (http://data.worldbank.org). Parallel figures for the United States showed similar trends. The U.S. Energy Information Administration estimates that national electricity transmission and distribution losses average about 6% of the electricity that is transmitted and distributed in the United States each year (average of losses from 1990 to 2012: www.eia.gov).[4]

3 One aspect omitted here (for methodological reasons) is the creation of new national production chains and employment from the expansion of the sector dealing with the production, installation, and maintenance of the proposed local energy systems; for more in this, see the specific literature (Sastresa et al, 2010; del Rio e Burguillo, 2008).

4 Compare electric power transmission and distribution losses (% of output) in other countries (2011): Denmark (7), Sweden (7), United Kingdom (8), Portugal (8), Spain (9%), Turkey (14%), Argentina (14),

Furthermore, a network of scattered systems could better handle the question of harnessing and recycling residual heat for other energy uses, as against the prohibitive costs of channelling the residual heat dispersed by large power stations over distances (Butera, 2007).

4.2. Reduction of network overheads

The self-contained energy within the local systems will mean less drain on the public univeral grid (lines and transformers), and consequently a reduction in overheads for the grid itself (ESG, 2014). In time, the local networks could gradually replace most of the public global grid.

4.3. Reducing pollution

The key feature of local energy systems is the opportunity they provide for harnessing renewable energy sources.
It is common knowledge that traditional power plants employing fossil fuels (in particular coal, natural gas, and oil) cause the emission of billions of tons of CO2 into the Earth's atmosphere per year: in the year 2012 that quota reached 34.5b (Oliver et al. 2013). Of the 14,000 billion Watts that the Earth's inhabitants consume every year, some 25% currently derives from coal, 20% from natural gas, 33% from oil, and 7% from nuclear; whereas from sunlight or other renewable sources, such as wind-power and geothermal, that quota stands at a meagre 0.5% (Kaku, 2011). Confirming the global intransigence in the use of fossil fuels is the fact that the percentage recorded forty years ago (1973) has remained the same: world 91%, and OECD countries 95% (Fig 3).
Also worth noting is that our cities use 80% of that energy (Butera, 2007). Furthermore in Italy and Europe, greenhouse gas emissions stem largely from urban areas and residential use (ISPRA, 2013; EEA, 2012). The reason for this is the continued poor implementation of the technological know-how for the use of on-site cogeneration plants and the continued use of old plants running on fossil fuels. As underlined by Akorede et al. (2010), it has been shown how the "*adoption of distributed generation technologies in power systems can play a key role in creating a clean, reliable energy with substantial environmental and other benefits. For example, a British analysis estimated a reduction of about 41% of CO2 emissions in 1999 when a combined heat and power (CHP) based distributed generation (DG) technology was adopted. In the same vein, a report on the Danish power system, observed a cut of 30% in greenhouse gas emissions from 1998 to 2001, with a widespread of DG technologies*."
Furthermore, distributed plants of this nature slot far more readily into the territory and landscape, with far less physical and visual impact on the environment.

4.4. Reduction of electromagnetic radiation

It is important moreover to take into account the other negative side-effects of large power transmission systems, such as electromagnetic pollution and the consequent risk to health. As noted by Akorede et al. (2010) *"the magnetic field directly underneath a transmission line is in the range of 300 and 600 mG, and has a field strength of between 10 and 100 mG at some 61 metres away"*. An investigation made by Draper et al. (2005) shows a 70% increase in childhood leukaemia for those living within 200 metres of an overhead transmission line, and a 23% increase for those living between 200 and 600 metres, both of which are statistically of crucial significance.
The health risks from electromagnetic radiation would be dramatically reduced with the introduction of a polycentric network based on local energy systems.

4.5.Reduction of blackouts

The presence of multiple local energy systems will also greatly reduce the risk of network power outages typical of the current unified grid system, which affects all users alike (with heavy economic consequences). In the case of distributed energy production units, the vulnerability of the entire system decreases because of the independence from the global electricity distribution grid.
It is worth noting also that the proposed distributed system would be far less vulnerable to possible acts of sabotage.

Brazil (16%) (http://data.worldbank.org).

4.6. Increase in self-sufficiency for consumers, and differentiated and tailor-made solutions

The distributed generation systems would promote the creation of non-hierarchical and competitive networks, with an increase in local self-reliance and a greater range of solutions (tailored to individual and small groups needs). Observe how this may also positively affect consumer awareness, and hence consumption behaviour patterns (Alanne and Saari, 2006). Furthermore, this type of system would be more flexible.

5. A framework for the diffusion of local energy systems: market, rules, and organisations

Infrastructure is only one part of a far-reaching system composed as follows:

- the economic sectors, such as transport and petrochemical;
- national and international markets;
- specific industries that produce energy plants running on traditional or renewable sources;
- institutional, regulative, and fiscal frameworks.

Recent research has shown that technologies co-evolve with the institutions, and the social and political, forming a socio-technological system, as it were (Goldthau, 2014; Geels, 2002).

The current institutional and regulative system has most certainly played in favour of the large technological systems, establishing a framework of rules that have fostered the emergence of a superstructure of giant energy providers cohering in a single global mega-network.

The traditional model of centralised technologies is so deeply embedded in the system of norms governing industry ad society that attempts to introduce changes of any kind – let alone radical ones – are strongly resisted. In the course of time this entrenched model has spawned mammoth sector monopolies and consolidated the mechanisms that preserve the status quo.[5] In the case of the energy grid, it largely functions as if it were a "natural" monopoly. The combination of economies of scale and subadditive firm costs prevents any new operators from gaining a foothold in the market, and their attempts trigger new preventive regulative barriers that favour the monopolistic powers (Gomez, 2013; Joskow, 2007). Here and there, efforts to support local energy production has threatened the profit margins of the incumbent giants (Crouch, 2014), unleashing waves of sector lobbying activity with the regulating bodies (as regards Germany for instance, see Vasagar, 2014).

In short, the major centralised energy plants using traditional technologies have created solid bonds with the socio-economic and geopolitical authorities. "Present regulation often does not allow nor gives the right incentives to the network operator to interact with generation, storage, flexible loads and aggregators in order to harvest the efficiency benefit they can provide" (Friedrichsen et al, p.266).

Italy for example, in 1980 still had 91% of energy production in traditional fields, falling to around 70% in 2013 (UP, 2010; IEA, 2014). In the first quarter of 2015 the country's renewable energy sources accounted for almost 31% of the net domestic energy production (Terna, 2015); given that almost half of this figure is owed to large hydro-electric plants, it becomes patently clear how far we still are from establishing a network of distributed small energy production units (based on renewable sources).

The current energy production framework with its entrenched reliance on traditional sources is drastically at odds with recent EU energy policies (in particular as regards the 2020 climate and energy package*;* EU, 2011; da Graça Carvalho, 2012), which are aimed at reducing CO2 emissions (reducing 20%) and at promoting a changeover to renewable energy sources (raising to 20% of the total) for the year 2020. Goals of this nature cannot be reached without somehow getting round the reigning monopolies, and without forming regulative frameworks that facilitate decentralisation and the creation of new legal arrangements for the transition from a *passive* energy society to an *active* one.

This transition is made possible by the continuous advances of technology, which now justify investing in

5 As shown by the reports of Transparency International on lobbying (Transparency International Italia, 2014), and by the overview proposed by Foldvary and Klein (2002).

polycentric units of energy production, in particular in solar-based systems (Farel, 2012). On this subject, there is a crucial need for the statutory energy utilities to reposition themselves on the market and in the production and distribution chain in light of the potential arrival of new competitors such as the Community Energy Enterprises (Vasagar, 2014).

The current regulatory framework in Italy and in most EU countries is focused on creating incentives for individual technological solutions, such as "Titoli di Efficienza Energetica" (Energy Efficiency Tokens) or "Conto Energia" (Energy Account) (ESG, 2014), by-passing the idea of collective solutions.

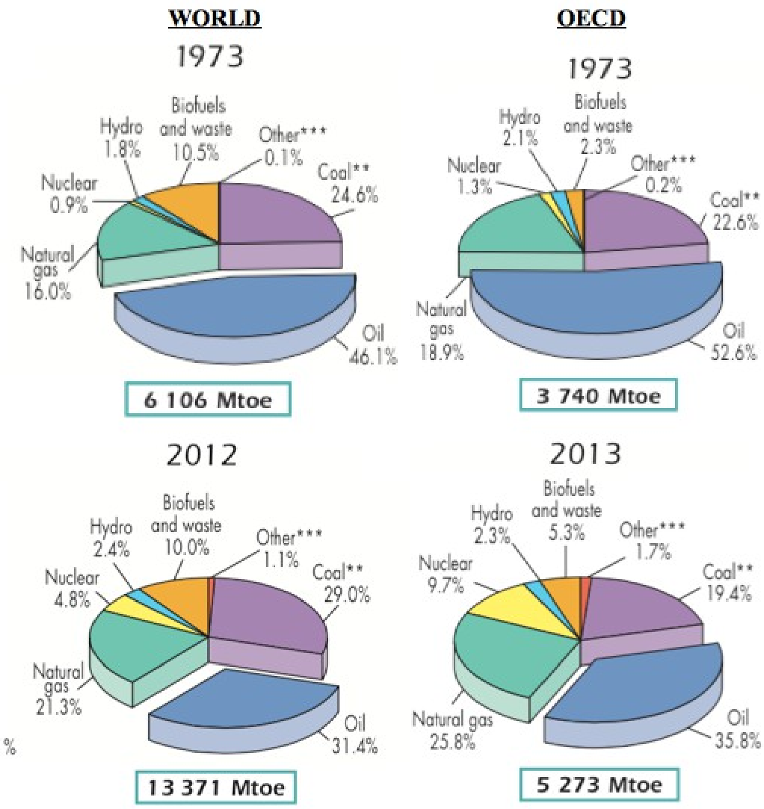

Figure 3. World and OECD area energy primary production supply sources percentage after 40 years (IEA, 2014).

In terms of public decisions and governance, the diffusion of local energy systems poses something of a challenge. Despite the steady fall in investment costs, it is essential that incentives and tax cuts are applied for the creation of local energy production networks, which will also guarantee solar grid parity (SGP), whereby the cost of on-site energy production through renewable sources (e.g., solar) is lower or compares favourably to the average costs currently available on the traditional utilities market.[6]

Among the policies for promoting a widespread access to energy self-sufficiency, some of the most important are new forms of ownership of the installation themselves. For example, third-party ownership (sometimes referred to as "solar leasing") is a long-term contract between individuals and a third party that installs, owns, and operates the solar electric system on your property. "The third-party ownership is able to

6 This approach aims to foster new arrangements or incentives in order to create the conditions for affordable and efficient local energy systems. It has been tested out by several local American municipal councils in tandem with the Institute of Local Self-Reliance, a research body for local energy systems advocacy. The policy changes proposed in the document entitled "Rooftop Revolution" (Farel, 2012) cover several important features of the approach: "*Rooftop solar transforms Americans from energy consumers into producers. Each house with a solar rooftop has (on average) two voters who will strongly support smart solar policies. When half of Americans can install solar for less than the cost of grid electricity (in 12 years), it makes a political majority that favors local ownership of localized energy production long before solar power becomes a significant portion of total electric generation*."

capture the federal tax incentives (including depreciation, otherwise not available to individual residential users) and therefore can compete favourably with those making cash purchases of solar power for their homes" (Farel, 2013; an example of this kind is described below in chapter 6).

In general, it is important to note that the cost of photovoltaic modules dropped about 80% between 2007 and 2012, and prices are continuing to fall (Newcomb et al., 2013). So called "soft-cost" (namely, all other costs beyond the module itself: installation, and permission and inspection procedures) can be significantly lowered by streamlining public procedures (ibid.).

6. Community Energy Enterprises: two types and examples

The composition of Community Energy Enterprises can vary as follows:

- a coalition of local public authorities/governments;
- a coalition of private individuals/groups forming an innovative unit that offer an alternative to local authorities for proposing new formulas of urban growth and energy supply (Bailey, 2012; Brunetta e Moroni, 2011; Tricarico, 2014).

6.1. First case: local energy systems as local government coalitions – the Cogeser Group

Cogeser was set up in 1986 as a Consortium between the municipalities of Melzo and Vignate (near Milan) to manage the supply of domestic gas (Lombardia Region, Italy). Since the year of its foundation up until 2001, a total of seven separate municipalities adhered to the consortium.
Some time later the consortium became a quoted company, Cogeser Spa, and an offshoot of the new company took over handling the distribution (Cogeser servizi Srl).
Since 2007 the company has consisted of three operational branches:

- *Cogeser vendite srl*: for the sale of gas and electricity;
- *Cogeser servizi srl*: for the management of street-lighting, the gas distribution network, and the management of new energy production services through renewable sources (photovoltaic and solar thermal), along with the co-generation of remote heating for a segment of the member municipalities (Fig. 5);
- *Cogeser servizi idrici srl:* water mains services and distribution utility.

The utility's ownership of the distribution and production system, together with the sales network, has enabled Cogeser to optimise its management performance: +11.8% profits in 2013, entirely redistributed among the member municipalities (Turati, 2013). At the same time, the cost of utility bills has dropped significantly, and Cogeser has guaranteed utmost transparency to the user community, along with all information regarding management policies and production (publishing its annual report). In addition, special local policies are put forward such as "gas bonus", namely a discount on utility bills for large low-income families, a perk that in 2013 alone benefited some 1,164 clients, to the tune of around 30 thousand euros (*ibid*.). Moreover, the group effects numerous special initiatives in its catchment area, such as sponsoring cultural events, or raising awareness in schools on environmental issues, and internships within the company for students from the area's high schools.

Figure 4. Maps showing the member municipalities of the Cogeser utility network (http://www.cogeser.it)

The success of the investments completed on the local dominion stems from the astute formula of integration between service management and ownership of the distribution network, which has enabled investment in cogeneration and district heating systems, along with photovoltaic plants in schools and other public buildings in the member districts. Recent years have also witnessed the outlay of interest-free loans for upgrading heating plants in the individual homes and condominiums (Lojola, 2008).

6.2. Second case: local energy systems as private community coalitions – the Melpignano "Comunità Cooperativa"

Among the examples on Italian context, the CC (community cooperative) of Melpignano near the southern city of Lecce (Puglia) has provided a significant yardstick for of collaboration, in this case between the Legacoop (a nationwide network of cooperatives) and the local municipal councils. As a working concept, the CC was created to handle a network of solar energy production via photovoltaic panels mounted on public and private buildings across the city; endorsing this was a third-party ownership scheme in the form of a community cooperative, namely an experimental form of organisation entrusted with managing the local council assets and services (Bartocci and Picciaia, 2014; Tricarico, 2014; Legacoop, 2011). According to the CC's statute (art. 5), this organ was appointed to install the plants and see to their upkeep, managing the production of energy via smart metering tailored to the needs of the end-users, and selling any excess energy back to the market. In truth, the company offers a potential multi-utility structure, inasmuch as its activities include the distribution and supply of combustible gas and water resources, along with the management of the services offered by the energy grid. From a legislative viewpoint, the setup could be reconfigured as a normal mixed cooperative (which would comprise production and consumption at the same time).

The participation of the various members of the cooperative is discretionary, depending on the duties they perform: autonomous worker members who supply technical know-how and actually build the plants; user members who are grouped into "host" members (i.e., citizens who host photovoltaic panels on their roof), and "simple" members who subscribe to the project via a fee in order to benefit from energy discounts; and subsidising?? members, namely those opt to invest in the project by contributing capital for its completion.

Thanks to the joint efforts of three partners, a unit was set up to run operations through a signed agreement, comprising the municipal administration of Melpignano (which oversaw the general scheme), the Officina Creativa of Lecce (which coordinates activities), and Salento university (which drew up a feasibility study for installing banks of photovoltaic cells on rooftops in Melpignano – identifying around 180 households with a suitable roof – and a schedule for implementing the project).

The successful realisation of the CC plants in Melpignano was feasible thanks to the detached single-unit housing typology, with accessible roofs (each of which ceded the use of their roof to the cooperative for a period of 20 years, whereby they receive free energy in return).

As for the financial resources needed, these came from the "Copfond" (one of the Legacoop's ventures), the "Banca Etica", a third-party owner (the cooperative itself), and partly through a subscription fee paid by members. Through these funds the cooperative has managed to repay the interest on the initial outlay, and also create its own savings fund. How the earnings from investment are employed is decided by the members, and so far goes toward urban requalification, such as improving greenspace, resurfacing roads, school bus services, and school cafeterias.

7. Closing remarks

A look at the situation in Italy shows that in the last twenty years there was been a steady increase in utility costs (NE, 2013), largely due to a dependency on imported raw materials, the lack of market liberalisation, a thorough overhaul of the national energy grid (Bitetti and Rocca, 2014), and not least to the government's resorting to energy taxation as a way of harvesting public money. This situation could lead to a worsening of the what is know as "energy poverty" (Faiella and Lavecchia, 2014; Oldfield, 2011), whereby some members of the population are not able to purchase the necessary minimum of energy assets and services.

For this reason it is critical that we question the present framework of state control over the energy grids and infrastructure, which is currently configured on a centralised model of production and distribution.[7] As Nele Friedrichsen et al. (2014, p.273) write: "*Decentralization is changing the structure and operation of electricity distribution. Consumers, generators and other stakeholders become more active participants in the electricity supply system and thus challenge the traditional responsibility and scope of action of the network operator*."

It goes without saying that a distributed energy system must likewise establish a set of safety and security standards. In this case, the principal "infrastructure" that the State can offer is the guarantee of universal legal safety and security standards, stable and impartial, that will guarantee equal access to new options and a "framework for utopias" (Nozick, 1974).

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