S U S T E L N E T

Policy and Regulatory Roadmaps for the Integration of Distributed Generation and the Development of Sustainable Electricity Networks

REGULATORY ROAD MAP FOR ITALY

Regulatory Road Map for the Deployment of Distributed Generation in Italy

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Preface

Technological developments and EU targets for penetration of renewable energy sources (RES) and greenhouse gas (GHG) reduction are decentralising electricity infrastructure and services. Although liberalisation and internationalisation of the European electricity market has resulted in efforts to harmonise transmission pricing and regulation, no initiative exists to consider the opening up and regulation of distribution networks to ensure effective participation of RES and distributed generation (DG) in the internal market. The SUSTELNET research project provides the analytical background and organisational foundation for a regulatory process that satisfies this need.

Within the SUSTELNET research project, a consortium of 10 research organisations analysed the technical, socio-economic and institutional dynamics of the European electricity supply system and markets. This has increased the understanding of the structure of the current European electricity sector and its socio-economic and institutional environment. The underlying patterns thus identified have provided the boundary conditions and levers for policy development to reach long term RES and GHG targets (2020-2030 timeframe). Consequently analysis was made as to what regulatory actions are needed in the short-to-medium term to reach the existing medium-term goals for 2010 as well as likely scenarios for longer-term goals.

Regulatory Road Maps
The main objective of the SUSTELNET project was to develop regulatory road maps for the transition to an electricity market and network structure that creates a level playing field between centralised and decentralised generation and network development. Furthermore, the regulatory road maps will facilitate the integration of RES, within the framework of the liberalisation of the EU electricity market.

Participatory Process
To deliver a fully operational road map, a participatory regulatory process was initiated throughout this project. This process will bring together electricity regulators and policy makers, distribution and supply companies, as well as representatives from other relevant institutions with the final objective of enhancing implementation of DG.

Newly Associated States
The SUSTELNET project also anticipates the enlargement of the EU by providing support to the Newly Associated States (NAS) with the preparation of a regulatory framework and thus also with the implementation of EU Directives on energy liberalisation and renewable energy in four Accession Countries (The Czech Republic, Poland, Hungary and Slovakia).

Project Structure
The SUSTELNET project was divided into two phases. During the first phase, the analytical phase, three background studies were produced:

- Long- term dynamics of electricity supply systems in the European Union.
- Review of the current electricity policy and regulation in the European Union and in Member States.
- Review of technical options and constraints for the integration of distributed generation in electricity networks.

In the second phase, the participatory regulatory process phase, two activities took place, during which there were extensive interactions with regulators, utilities, policy makers and other relevant actors:

- Development of a normative framework: criteria for, and benchmark of distribution network regulation.
- Development of policy and regulatory road maps.

This Report
This report was produced during the participatory regulatory process phase of the project and is part of the development of policy and regulatory road maps.

EXECUTIVE SUMMARY

The following work aims to define the necessary regulatory steps over a period of almost 20 years, in order to allow to Distributed Generation to compete at the same level (level play field) of traditional centralized power plants. The approach is mostly focused on the necessary improvements in the regulatory structure of the distribution networks.
We present a series of considerations on the trends of the Italian market and consequent measures to induce an efficient introduction of the new technologies.
The methodology includes the definition of basic market scenarios, which serve as a background to the description of the transition towards a more advanced definition of the networks under a higher share of DG and RES.
For practicality reasons we have fully analyzed only one scenario, which refers to a situation of an increase in market liberalization and a favourable regulatory attitude towards DG. The consistency of the roadmap is checked for robustness, comparing the results under different assumptions.

Regulatory road Map

Among the critical points we can differentiate those country specific (from a to h) and the general issues (points i and j), which are some of the main results of the projects.

a) The need to have long term coordinated (between the relevant public institutions) specific policies on RES and DG to introduce the premises of a stable regulatory environment, which would reduce the investment risk, both in the distribution and generation sectors.

b) A specific non-discriminatory regulation for connection and network investments.

c) A continuous support for network investments and energy efficiency measures.

d) The introduction of locational economic signal for the connection of new generators.

e) The introduction of transparency requirements on the data concerning the demand of final customers.

f) A clear appraisal of the status of the unbundling requirements.

g) Non-discriminatory rules for market participation, in order to allow to smaller player to participate to the trading in the day ahead and balance (including ancillary services) markets.

h) The support for new entrants in the markets, especially brokers, who should function as aggregators (coordinators) of the production and the supply to the market of DG produced electricity.

i) In order to achieve ‘active networks’, DNOs have to evolve from passive organisations into more active actors. In other words, DNOs have to become active and innovative entrepreneurs that would facilitate and profit from the connection of DG into the system. By doing so and because DNOs would receive the benefits DG creates, they would on the one hand be provided with incentives to connect DG and, on the other hand, provide the correct signals to generators and consumers in order to efficiently behave concerning the network. Along the regulatory road map, it is assumed that a change in the DNO’s business practices is achieved.

j) In order to provide the DNOs with instruments to gain in flexibility and allow them to actively manage the network, a system composed by shallow connection charges plus an 'entry charge' is implemented in the regulatory road map. The entry charge is a use of system charge for feeding into the network, and it can have a positive, zero or negative value. The entry charge, charged entirely or partly during the lifetime of the DG plant, avoids prohibitively up front large connection charges. It also allows the DNOs to give locational incentives by differentiating in place and time.

1 INTRODUCTION

The principle of regulatory road maps can be derived from technology road maps[2]. Technology road maps describe possible routes of technology development and show the probable date of market introduction. Often, technology road maps also indicate the intermediate steps and timing of technology development.

In the context of SUSTELNET a road map is a guide to the development of electricity regulation[3]. A road map stipulates the regulatory actions that are necessary to reach a desired future state of market organisation. In SUSTELNET this desired future state is described as a 'level playing field' for centralised and distributed generation. This broadly means that centralised and distributed generation should be able to participate in the electricity market on equal terms. This rather general conception of a level playing field is expressed through criteria for electricity regulation.

A road map contains a series of regulatory actions and developments. Furthermore, the road map indicates the timing of regulatory steps. The timing of these steps depends on key developments in the electricity sector and the penetration of DG in the electricity market. The level of detail in the description of the regulatory actions is higher for the short-term actions than for the long-term actions. Finally, considering that regulation never takes place in isolation, a road map should address all stakeholders.

This report outlines the regulatory roadmap for Italy. Chapter 2 describes the present situation of the electricity market: the supply structure, the environmental policy and the system of governance; these topics are considered taking into consideration the developments over the time horizon of the project. Chapter 3 consequently outlines the regulatory steps that need to be taken in order to establish a level playing field for distributed and centralised generation against the background of the developments described in Chapter 2. In Chapter 4 these regulation strategies are tested on their robustness and effectiveness to respond to changing circumstances in the electricity sector. Chapter 5 concludes with an action plan that addresses the responsibilities and tasks of all stakeholders in implementing the regulatory roadmap.

[2] Examples are: Electricity Technology Roadmap, EPRI, 1999
(http://www.epri.com/corporate/discover_epri/roadmap/index.html)
Hydrogen energy and fuel cells - a vision for our future, European Commission, June 2003
(http://europa.eu.int/comm/research/energy/nn/nn_rt_hlg2_en.html)

[3] For more information on the development of regulatory road maps, see "Outline for Developing Regulatory Road Maps" by E.J.W. van Sambeek, M.J.J. Scheepers and A.F. Wals on www.sustelnet.net

2 SYSTEM ANALYSIS AND SCENARIO DESCRIPTION

2.1 Introduction

Scenarios
This document describes a set of regulatory steps to reach an efficient deployment of Distributed Generation (DG) in a long-term horizon (up to 2020).
Our analysis is based on certain assumptions concerning the general state of the electricity system. This set of assumptions has been called a scenario; in the project four scenarios have been built, but only one has been chosen to develop the roadmap. The other scenarios have been used to compare the robustness of the recommendations developed under different conditions.
We suppose as a basic set-up a favorable regulatory environment for DG and RES (i.e. ambitious DG and RES targets and strong support schemes), both at national and EU level, with fair access to the grid.

DG Definition
It is necessary to give our definition of DG to understand the focus of our study. In the following table it is possible to notice how we consider only small-scale units excluding from DG large CHP and RES.

Table 2.1 - Characterisation of Distributed Generation

	Combined Heat and Power (CHP)	Renewable Energy Sources (RES)
Large scale generation	• Large district heating* • Large industrial CHP*	• Large hydro** • Off-shore wind • Co-firing biomass in coal power plants • Geothermal energy
Distributed Generation (DG)	• Medium district heating • Medium industrial CHP • Commercial CHP • Micro CHP	• Medium and small hydro • On-shore wind • Tidal energy • Biomass and waste incineration/gasification • Solar energy (PV)

* > 50 MW_e
** > 10 MW_e

2.2 Electricity Supply

There are no precise statistics in Italy for DG since it is not treated as a specific sector; there are only estimates, which place the share around 6GW. What we are going to show is the present situation for each generation technology and forecasts made by the Regulator (AEEG) in the 2003 yearly report according to different scenarios of economic growth.

Table 2.2 - Actual and forecasted production

TWh	2000	2001	2002	2005 LG	2005 HG	2005 LCHP	2010 LG	2010 HG	2010 LCHP
Total Generation	276.8	278.9	283.6	303.4	310.6	302.2	344.3	369.4	340.2
Hydro/RES	51.4	55.0	49.5	56.1	56.1	56.1	68.0	68.0	68.0
Thermal	218.5	216.8	226.6	238.0	245.0	237.7	263.7	287.9	262.6
CHP	n.a.	45.0	47.2	53.9	53.9	52.0	65.0	65.0	52.0

In table 2.2 we can see production figures until 2002 and forecasts for 2005 and 2010 considering three different conditions: low economic growth (LG), high economic growth (HG) and low penetration of CHP (LCHP). This last scenario describes a set of regulatory measures against CHP in terms of authorization and connection procedures, it has to be pointed out that the quantity of CHP is included in the figure for thermal.
It is possible to find some data on the website of the TSO (GRTN) on the generating capacity according to technology. For **CHP** the quantity in 2001 was **8234 MW**, out of these only **865 MW** came from units of a size under 25MW. The total Thermal capacity was 52047 MW.
The following table reports values for RES for 2000 and 2001.

Table 2.3 - RES Generating capacity

	units	MW	units	MW
	2000		2001	
Hydro (Total)	1958	16641	1926	16726
Hydro 0-1 MW	1122	373	1080	384
Hydro 1-10 MW	544	1823	553	1849
Hydro >10 MW	292	14444	293	14493
Wind	55	363	81	663
PV	9	6,3	11	6,5
Geothermic	33	626	30	573
Biomass/Waste	186	685	202	740
Total	2241	18322	2250	18710

In the long run forecasts can be made according to a growth in demand, which should be on average a 2% each year, still it is difficult to be precise in terms of generation technology. The reason is that choices can be influenced by national energy policy, which at the moment is not clearly specified, especially for the medium long-term horizon.
In the short run (2006) there will be the entry of recently authorized gas fired generation capacity for an amount of 8GW, which will affect considerably the offer's structure. The Italian supply and demand structure reveals a shortage of capacity, even considering the full exploitation of interconnectors[4]. The regulatory focus now is on this issue, which has been the cause of the summer blackouts; since DG does not seem to be the right instrument to face this type of emergency possibly it is not considered a short-term priority.
In terms of imports it has been approved a law, which allows merchant lines to connect foreign grids to the Italian network; the private investors will own the 80% of import rights for 10 years. There will be no additional compensation for the owners and the new grid will be managed by the GRTN. The scope of such a measure is to increase the quantity and the reliability of supply of foreign electricity.

[4] Imports at the moment have a large impact and account for 16% of the overall consumption.

2.3 Market Structure and Governance

2.3.1 Analysis of Supply

The market structure is characterized by two main factors: nonetheless in the period 2001-2003 ENEL was forced to sell 15 GW of generating capacity, it is still the main player in the market with approximately 45% of the production; secondly more than 20% of the national production comes from electricity produced under incentives programs (CHP and RES), which is bought and traded by the GRTN.
In the table below we report the 2002 production figures only for the main producers, These are subject to evolve soon since there are many plants, which are under a process of re-powering or had a change of ownership (i.e. Interpower was sold to Tirreno Power a joint venture of ACEA Roma and Electrabel).

Table 2.4 - Shares of electricity production in 2002

ENEL	43,5%	Edison	13,4%
Other CIP6[5]	10%	Endesa	6,8%
Edi Power	4,2%	ENEL Green	3%
Eurogen	2,8%	AEM Milano	1,4%

Clearly there is a big concern of a market with a lack of competitiveness, since the even the entry of already authorized generating capacity in 2006 will not fundamentally alter the market structure. Another potential problem is the vertical integration with the distribution and retail sector: ENEL and all the large municipalities own generating assets, which are only legally unbundled[6].
The future development will be possibly in the retail sector, which should be open in 2007. One of the main objectives at the moment is to increase the number of eligible customers in order to promote competition; there are specific rules, which allow the aggregation of small consumers into buying groups, which will as a consequence be able to participate to the bidding on the Power Exchange and the standard trading through bilateral contracts.
What it lacks at the moment is an understanding of the degree of competitiveness, which keeps uncertain the exact profitability of new entrants. It will be necessary a period of adjustment until reliable data will emerge after the opening of the Power Exchange in 2004. In order to understand the profitability of DG it is necessary to assess the degree of volatility of prices and the differentials induced by congestion pricing. Especially for the second case it is quite difficult to have figures based on simulation models[7].
For what concerns future developments DG seems like an interesting business for most of the market players, which already have been started to study the possible applications. The degree of penetration will depend also on the general attitude towards centralized generation and transmission expansion; at the moment there are often obstacles to have communities to agree on new lines and large generators. DG could be a faster way to augment individual capacity, especially in a scenario where network expansion and connection procedures and requirements would be pro-DG.
An important input for DG would be to have available data on final customers; in a vertically integrated market with several intertwined interests, it seems necessary to guarantee a high

[5] CIP6 is an incentive program to cover fixed costs of CHP and RES plants, we specified other since we do not include the production from plants of large companies. The total CIP6 production accounts approximately for 20%.
[6] In Italy 90% of distribution grid is controlled by ENEL, the rest is controlled by municipalities (data referring to the numbers of customers). The three main cities Roma, Milano and Torino have their own distributor/supplier, which in terms of size correspond to small utilities.
[7] The Italian market will account for congestion introducing zonal pricing, which can be used as short-term signals to introduce new generating capacity.

degree of transparency. Considering the possible impact of DG on Demand Side Management, it is necessary to fully understand the load characteristics to place and operate efficiently the machines.

2.3.2 Environmental Policy

The following is table with the governmental targets of RES published in a document published at the end of 2002.

Table 2.5 – National Objectives for RES

Year	Electricity Consumption (TWh)	RES Production (TWh)	RES Imports (TWh)	Share of RES Consumption (TWh)
2003	317	55	12	21,1
2006	337	59	12	21,1
2008	350	63,5	12	21,6
2010	364	70	12	22,5
2012	379	76	12	23,2

The main method of support for RES is a system of tradable Green Certificates: each producer (except electricity produced by CHP plants) and importer has an obligation to supply 2% through RES, otherwise they can buy GC either through bilateral contracts or through a market organized by the power exchange. Only plants, which came on-line after 1999 are allowed to be qualified for the program; this authorization will expire after 8 years, after the initial incentive period, plants should be able to participate directly to the market. The reason of the time limitation is to guarantee the entry of new RES plant; still it is questionable, due to the possible increase in demand, if the 2% quota in the long term will be sufficient to satisfy the European targets.
In practice there are several implementation issues, which should be solved or clarified; especially there is a sort of overlap with previous incentives programs (CIP6), which could create uncertainty for potential investors. It has to be pointed out that the mechanism is market based; as a consequence there is a need of transparency on authorization and participation procedures and any rule concerning market outcomes. It is expected that the mechanism will not penalize too much consumers selecting efficient sources.

Long-term topics

- It seems that even if eight years is a reasonable amount of time, still there should be guidelines and a commitment on future integration of RES in the market. At the moment there is an obligation for the GRTN of priority of dispatch, but this is not enough to assess the future competitiveness of different sources.
- GC have the minimal size of 100 MWh, which is a rather large amount; it is admitted the possibility to have joint offers by several producers, still it should be verified that this would not exclude small producers, which for specific technologies could have excessive transaction costs.

There is a recent energy to promote the efficient use of resources, which forces Distributors with more than 100.000 clients to develop specific projects within their customer base. Firms can either operate themselves or pay an ESCO; there is also the possibility to buy the certificates by other firms having implemented projects approved by the AEEG. There are several basic technical options, among these small CHP units. Part of the costs, will be recovered through the electricity bill of final customers. This is another attempt to give a more dynamic and market related set of incentives, promoting a sort of competition among different methods of Demand Side Management. Here there is the possibility for the distributor to have an active role affecting the structure of the demand and consequently to face new technical challenges.

2.3.3 Governance

The Italian system of governance relies on the Ministry of Industry (Ministero delle Attivita' Produttive) and the Regulator (AEEG), other institutions involved are the Ministry of Environment and the Competition Authority (AGCM).
The role of the regulator concerns issue like tariffs (transmission, distribution, energy prices for captive customers), reliability and quality standards, technical matters (connection charges, CHP parameters). The Government is in charge of the Energy Policy including market-design and support programs; on these matters the AEEG has only a role of support to the decision-making process. The weakness of such a structure is the difficulty to commit to long-term reforms; the reason is that governments are subject mostly to short term interests, with a need of action with fast visible results. In order to have a large increase in the quantity of DG (and wind in general) there is a need of a restructuring of the distribution sector/network[8], which requires a continuous and harmonized process of reforms over several years; then the need of a legislative authority, which could guarantee the implementation of basic technical reforms.
As an example we can quote the state of current transition of the market, with a reform started in 1999, still far from being completed, and the introduction in the mid 90's of the CIP6 support mechanism for RES and CHP, which did not specify for the distributors precise guidelines for connection and network development.

Recently there has been a "federal" reform, which gave competence to Regions[9] on energy issues. There are possible positive aspects, since Regions could be more dynamic in capturing favorable opportunities, but there is the risk that decision could go against a system, which has been planned at national level. In a DG supportive scenario it is advocated a high degree of harmonization at EU level, the risk of leaving too much local power is an increase of transaction costs (possible different procedures for authorization and operation) and a lack of technical standardization, which would not allow firms to exploit natural economies of scale.

2.4 Critical Points

In this section are summarized the critical points in order to comply with a scenario of high penetration of DG:

- There should be a large governmental support for RES and DG both at national and EU level. Policies should be harmonized and have a long-term perspective. Due to the possible concentration at EU level, large firms should be directly involved in developing and introducing new technologies; it would be wrong to associate DG only to small investors.
- Create a mechanism, which would consider globally the electricity system creating long-term locational signals for transmission/distribution network expansion. In the same framework develop coherently intermittent electricity sources (i.e. wind) with adequate resources for balancing power.
- To introduce in the medium term innovative solutions in terms of distribution networks, in order to operate the system in active rather than passive way.
- As the deployment of small units increases the problems of coordination typical of electricity markets, it is necessary to create an interaction in terms of network control and development between: TSO (GRTN) and Distributors; in terms of market integration between the power exchange (GME) and electricity traders, in order to give to DG effective access to the market. These actions have to be taken starting already in the short-term and have to follow the development of the system.
- To develop an active control of load with DSM techniques, improving the use of ICT technology.

[8] There is a clear impact also at the transmission level.
[9] There are 21 regions; large ones have a considerable political and economical impact.

- There is a need for specific support for technologies, which are not mature, in order to give them the possibility to be competitive in the medium term (i.e. 2010 for fuel cell based CHP).

3 REGULATORY ROAD MAP

3.1 Regulatory Steps

In this section it is presented a scheme with a series of steps to be followed in order to reach the active network/high market penetration stage.
In the table we set on the horizontal axis three stages of market penetration, on the vertical five stages of refinement of regulatory policy.
The principle is that DG penetration is linked to the development of the network; on the other hand a low level of DG does not require innovative networks (as marked in the gray area).

Table 3.1: Regulatory roadmaps scheme

			Level of DG/RES supply		
			Low A	Moderate B	High C
Market access			protected niche market	DG/RES in wholesale market	Level playing field
Network regulation	I	No regulation/ self-regulation	I-A	I-B	I-C
	II	Cost driven incentive regulation	II-A	II-B	II-C
	III	Refinement of cost driven incentive regulation	III-A	III-B	III-C
	IV	Innovative predominant passive network		IV-B	IV-C
	V	Innovative active network	No innovative networks required		V-C

It is not easy to determine a starting point for Italy due to the moment of transition. We chose I-B since we consider the large presence of CHP (even above 10 MW), which should be included in the opening of the power exchange in 2004. An alternative path could have been the sequence (I-A, II-A, III-B, IV-C, V-C), considering the present DG deployment as a niche market, which could be the case due to the reduced quantity of small units. The final result would not substantially differ in the two set-ups, as the final stages would still be the same.
What we show, marked by the arrows, is a development of the regulatory system; we can see how the switch to a level playing field is done before the change in the network configuration. It is necessary to remark the limitation of the table, which associates market integration with high percentage of DG in the system; the switch from III-B to IV-C concerns only a change in the effective participation of DG to the market, but does not imply any strong increase in the quantity deployed. In order to accommodate a large penetration it is necessary to reach stage V-C (innovative active network).

3.2 Regulatory Framework in its Final Stage

The target of the above road map is to point out the necessary regulatory steps to achieve a situation where DG and centralized generation could compete on the same level. To define this status we use the term of "level playing field", which intends to define a system; which is capable to recognize correctly costs and benefits of each type of technology, guaranteeing their correct exploitation.
There are several areas of intervention like market integration, connection costs, network expansion and use of system charges, which require adjustments in order to accommodate DG. For what concerns market integration it is necessary a minimization of the transaction costs incurred by the market operator dealing with a greater quantity of units. The last three issues concern the DNOs and their role in network development and the overall efficiency of the system; the key issue is a correct allocation of costs.
We suppose that distribution network should evolve including a different role for DNOs, which should reach an active status in network management with respect to the passive current organization. The concept is to integrate investments and interaction with demand in order to provide the most efficient solutions. The DNO should be able to use directly or indirectly (i.e. giving the correct economic signals) instruments like DG or DSM to improve the quality of supply. Given their better perspective of the status of the network and the customers' characteristics, it is a logic consequence that they should introduce and coordinate innovation.
In the following section we will present the current status of the system integrating each topic with an analysis of the regulatory principles, which should be followed in order to reach a "level playing field".

3.3 Current System and Proposal for a Reform

The following analysis has been done in a transition period[10]; we have anyway used the information, which we consider reliable to describe the current status as at the beginning of 2004.

3.3.1 Regulation of the Distribution Costs

In the proposed regulation for the period 2004-2007, there is a clear emphasis to pursue objectives, which go beyond costs minimization; the focus is on measures, which should promote investments and overall energy efficiency. There is an understanding of the fact that the role of the Distributor should be defined considering the overall growth of the system.
In the general principles is pointed out that the method of price cap will be applied to the operating costs, but not to the invested capital, which will be compensated at the same rate during the entire regulatory period. This value will not be based on the volume of electricity distributed in order not to create any conflict with actions of DSM, aimed to promote an efficient use of resources, which implies often a reduction of the overall consumption.
The Italian system has different sets of tariffs for each consumer group; the AEEG sets a national tariff, then the Distributors have the option to offer additional tariffs, which have to satisfy the constraints set by the AEEG.

[10] There are several factors to be considered: i) the new law concerning energy policy is still under discussion in the parliament; ii) the power exchange has not started yet its operations and the complete set of rules has not been yet established; iii) the decisions of the Regulator for the regulatory period 2004-2007 have not yet been published (we used the so called "Documento di Consultazione", which is the proposal of the Regulator discussed with market participants, before being approved).

There are two types of constraints: V1 is the maximal revenue for each consumer group; this is verified ex-post in the following year. The revenues have to be compatible with the tariff TV1, which is the amount determined by the AEEG. This is a two-part tariff with a fixed part for the connection charges and a variable part proportional to the consumption.
The second constraint is called V2 and limits the revenues for each single customer, the reference is the tariff TV2 set by the AEEG, which has three components: i) a fixed component for each customer, ii) a component proportional to the maximal load over a year, iii) a component proportional to the individual consumption.
The tariffs will be updated yearly through a price-cap method, as we mentioned above investments will be excluded; they will just be updated yearly just to report the quantity variations.
The components of the price cap are the following: I-X+Y+Q+Z, where:

- I is the average rate of variation of the consumer price index;
- X is the target of costs reduction;
- Y is the recognized increment in the tariffs for unexpected events (i.e. change of regulation, new obligations of universal service);
- Q is the rate of variation related to costs incurred to guarantee higher standards of quality of service;
- Z is the rate of variation related to DSM and energy efficiency measures.

Besides a national estimate of average costs, the AEEG will recognize specific regional factors, depending on the type of customers and the location of each distributor. The objective is to compute the effect of exogenous variables on the cost structure of each company, in order to effectively compare their efficiency.

The revenue cap method satisfies the conditions for an efficient development of a technology like DG, which diminishes the sales of the DNOs reducing the amount of electricity injected on the distribution network. The reason is that setting a revenue cap both on individual and group of customers does not push the DNO to sales maximization. On this basis it is easier to promote energy efficiency programs both on the demand and the supply side, since there are not countervailing incentives for the utilities.

In order to reach the desired change to active networks, DNOs should not be penalized for taking long-term investments, which could be accounted as inefficient in the short term. In any regulatory regime there should be also a great deal of attention to the type of assets used by each DNO on their network. Superficial comparisons should be avoided, in order to compensate correctly costly measures taken to improve efficiency and reliability.

3.3.2 UoS Charges

Charges are allocated between producers and final customers. There are favorable arrangements for DG operators, since they receive extra contributions from Distributors for the avoided transmission costs. Basically the amount, which would be paid to the TSO for the transmission on the HV network, is given to the DG operator. This rule is under possible revision since there are no compensations to the Distributors for the disturbances created by DG, since small units are not supposed to contribute for balance and reserve services.
The AEEG recognizes to DG the equivalence with respect to the expansion of the HV grid, still there is no formal link in the legislation. One positive aspect of the future regulation is the fact that there will be for transmission a system based on entry and exit charges, in order to give long-term locational signals, which should favor (even indirectly) DG.

3.3.3 Connection Charges

The rules for access are included in the Delibera 50/2 of the AEEG dated March 26th 2002. In general terms Italy adopts third party access procedures and the whole Energy Policy tends to

encourage entry of new generation. It is stated in the decree 77/99 that both the GRTN and local distributors cannot refuse access to the networks under their control and that there should be a non-discriminatory treatment for entrants.
The procedure starts with the network managers sending for approval to the AEEG the general conditions for access to the part of the networks under their control. These include the technical solutions available and the amount of time necessary to approve a project. Then the choice and execution of any project falls under the responsibility of the user, who has to follow one of the proposed solutions. The grid manager has the right to control and approve the connection before the beginning of operations. In the project phase the parties involved have to determine the parts of the connection for which they will have to be responsible in terms of future maintenance.
Since DG could damage in its operations the clients already connected to the grid, it is up to the DNO to establish for the DG owners a code of conduct.
It is also recognized the that some types of connections should be partly considered as general upgrade of the grid, for this reason the users should be reimbursed for the extra expenses (in economic terms the latter generate a positive externalities to other users). It is up to the user to notify this kind of situation to the network manager with the request of connection and discuss the financial conditions according to the guidelines fixed by the AEEG.
This new scheme is not yet in place and economic conditions of connections have still to be determined. At the moment the system forces the DNO to accept connection, still leaves to the DNO to compute the economic part[11], there is a special treatment for small generators since they are not charged for previous investments, but only for marginal costs. The system should be classified as shallow connection charges; still the case-by-case nature of the arrangements could leave room for different interpretations. This is a case of sort of ex-post regulation, where the developers, as has already happened, can bring the DNO to court whenever he considers unjustified the connection's costs[12].
The organization of the distributing sector is clearly a potential barrier for new entry; having ENEL and other distributors involved in activities of generation and supply, clearly raises concerns in terms of transparency of operations.

The desirable structure of connection charges in order to reach a level playing field should reflect all the costs induced by the entry of DG. This would translate in a system of deep connection charges, which anyway has great limitations due to the difficulty of quantifying precise values. There are problems to recognize the immediate benefits of grid reinforcement added to the system and future benefits for machines, which will be connected at later stages.
As these benefits are private information (or they could not be explicitly demonstrated) of the DNOs, the regulatory system should induce them to reveal the value of new connections, considering the overall development of their network.
It seems reasonable the method of presenting general guidelines to be controlled by the regulator, which should be completed with a set of entry charges[13]. These should account for short-term and long-term development and include locational signal reflecting network congestion; they could possibly be structured in two part tariffs, with variable costs to be recovered partly through socialization.

[11] It is not the point to go through the required procedure of technical authorization. It can be said that it is quite complex, mostly because it depends on several local and national institutions. This constitutes a great deal of work also for large firms like ENEL and Edison, which confirmed an average of four to six months required to complete the process. It is clearly one of the necessary steps to standardize and simplify the procedure. Unfortunately this is a common phenomenon in other business sectors, which penalizes small scale developments.
[12] In the Delibera 150/01 of July 2001 the AEEG recognizes (after a series of complaints) the excessive stranded costs imposed by ENEL Distribuzione computed as a part of concession charges. In the document is specified that ENEL was imposing standard charges to CIP6 producers, who had special and more favorable condition of access.
[13] Entry charges are structured as UoS charges.

We have two key issues: the necessity to induce the DNOs to reveal their information truthfully without overcharging new entrants and a need of standardization in order to help the regulator to verify the proposed solutions through a process of benchmarking.

3.3.4 Market Integration

In terms of dispatch DG and RES have priority access in dispatch, this includes units under incentive programs and the electricity sold to the TSO at tariff established by the AEEG, which varies according to market prices (electricity and fuels). The set of rules for the future power exchange has not been yet completed, still it seems that units under 10MWA will not be admitted to trading, they will have then to settle for the TSO tariff or for bilateral contracts. Anyway there should be the option for brokers to aggregate the supply of machines even with diversified ownership and offer them in the day-ahead market[14][15]. The concept of aggregation has been promoted on the consumer side, where it is possible to create purchasing consortia even for individuals with low consumption levels (1GW).

The organizational forms of restructured markets did not take often into consideration the presence of DG; still it is possible to foresee an efficient and profitable integration, given some necessary modifications both in the market design and the structure of supply.
A necessary requirement for any type of generator in order to participate successfully to trading activities is to have good knowledge of several kinds of information such as bidding rules, fuel prices, weather conditions, operational procedures. The costs of acquiring this information are largely fixed, giving an advantage to larger firms; they can also often determine the minimal profitable size for new entrants.
It is straightforward to realize that such an issue could have a negative impact on DG; still the natural barrier of large transaction costs is a characteristic, which does not rule out the profitability of DG. As a matter of fact the possibility to aggregate resources can solve the problem and allow DG to be competitive with respect to large generators: the principle is to have a single operator controlling multiple machines. Given this general intuition the next step would be to point out, what type of institution could be appointed for such a task. There are several solutions, which could range from the DNO to an energy broker, but there cannot be a general answer since the choice should depend on each market initial conditions and regulatory framework.
One principle, which is important to remind is the possible separation of control and ownership. It is not necessary that the two coincide: it can be the case that the controller offers a contract to a DG owner in order to exploit his machine. In such a set up there is an efficiency improvement: the controller has superior information about markets and can use the flexibility given by running at the same time multiple units. In this kind of situation we should be careful with the principle of unbundling, we cannot straight away associate vertical integration only with ownership, since control of machines could duplicate some of the anti-competitive effects. What should be analyzed is the type of contract between the controller and the owner and to foresee the effects.
Given the above considerations some recommendations can be proposed:

- To charge DG for the effective fixed costs of participation to the markets; it is unnecessary to allow participation if the transaction costs are not covered by the profits.
- To set up rules, which facilitate aggregation of resources. These should concern dispatch and market bidding. There is a need of creating a framework for the interaction of the controller with the TSO (dispatch) and the Power Exchange (bidding). These developments should be in line with the use of active networks and new protocol of

[14] Especially large companies are already studying the technical support needed for DG units to participate to the power exchange.
[15] This possibility could be applied in principle also to balance and ancillary services markets, anyway we did not find any explicit reference.

exchange of information.

- To establish market for ancillary services, where the TSO could not discriminate about the generating technology, but should just request neutral performance standards. Through aggregation DG can act as large generators and possibly improve the degree of reliability of supply, which is extremely relevant in emergency conditions.

3.3.5 Principles of DG Regulation

In order to complete the recommendations contained in the roadmap, it is necessary to state the set of basic regulatory principles developed in the SUSTELNET project (see Leprich and Bauknecht, 2004).

The introduction of DG alters the configuration and the control of the network, creating positive and negative effects with different time frames.

In general costs-benefits should be allocated for what concerns the short-term to the Dg plants, instead the long-term to the DNO. The rationale is to give the right incentives to connect and operate efficiently to the DG operators and to have the DNO taking care of long-term planning covering their investments through socialized network charges.

Another delicate issue is unbundling: if a DNO is either a generator or a supplier could see DG as a potential competitor. The consequence is that full unbundling (by ownership) it is strongly preferred, otherwise there should be a great deal of transparency on access rules both at network and market level.

Due to the importance of the topics we quote directly Leprich and Bauknecht on connection and UoS charges:

" The connection costs may also be an important factor, especially in cases where the DG utilizes natural resources that are located far from load centers. To discuss connection charges, we need to define (or at least describe) shallow and deep connection charges.

Shallow connection charges include only the cost of connecting the customer to the nearest point in the distribution network.

Deep connection charges include any cost of reinforcements of the existing network that have been made necessary by the new customer.

It is generally agreed that shallow connection charges (connection only) do not create a level playing field. When the full cost of connecting DG is not charged to the DG investor, economically inefficient investments in DG may be made. In addition, it does not give DG operators the right signal as to where to locate a new plant, and it might discourage DNOs from connecting DG.

With deep connection charges every new entrant is treated individually and will face actual marginal cost of connection. In theory this will give correct signals for investment. However there are some problems.

- *Economies of scale and first mover disadvantage: The initial investment in grid reinforcement may be large, but any later DG entrants will not induce any further investment cost. Therefore the first mover must not be charged for the entire investment.*
- *Meshed grids: Any grid reinforcement in meshed grids induced by DG may also benefit other customers. It may be argued therefore that such reinforcement costs should not be included in deep connection charges. However, if they are left out, DG investment will induce more such reinforcements than are economically optimal.*
- *Prohibitively large connection charges: In some cases the deep connection charges may be so large that any DG investment is discouraged. This, however, is a policy argument and not an economic argument."*

Use of System Charges should follow the two principles below*:*

- *Revenue-cap regulation: In its simplest form, limits to a predetermined level the amount of revenue per year that a firm can collect from its customer base. In particular, a*

revenue-per-customer-cap is argued to be the best system that does not bias against DG. A utility under this regulatory framework has a clear incentive to encourage minimal total demand, and thus minimal demand per customer. One way to do this is to encourage the efficient use of power. In other words, with proper adjustment, and in the right circumstances, a revenue cap might motivate both supply-side cost minimization and demand-side efficiency maximization without imposing too much risk or inducing perverse behaviour on the part of the utility.

- *Multi-driver cap regulation: When multi-driver cap regulation is properly applied, it can provide powerful incentives for economic efficiency on the supply-side, decrease the incentives to increase sales and therefore bias against DG and allow the inclusion of direct costs of DG programs.*

3.4 Development of the Roadmap: Future Regulatory Steps

In this section we will analyze the structure of the roadmap; the time frame is not necessarily binding, what is more important is the ordering of the proposed changes. As already stated we assume a favourable scenario for DG with a final rate of penetration higher than 20%, which requires a radical change in terms of network management.

3.4.1 Stage 2007-2010

In the time line this should be the first regulatory period, where there would be an explicit treatment of DG, due to the converging effort at European level to promote efficient technologies. What should be required is a plan to integrate DG and RES in the market, capturing their real benefits, avoiding fixed incentive programs, which do not stimulate growth correctly.
In terms of the Table 3.1 we are at stage III-B, meaning that there should be a precise policy in order to consider the increasing penetration of DG in the distribution network.
The current framework of a revenue cap should be maintained, improving the analysis of investments[16] in order to promote energy efficiency targets.
The principle would be to continue with a policy recognizing the extra costs incurred by the DNOs in terms of overall quality of service and the technology related improvements of the network.
The regulator should act as an aggregator of information concerning the choices of DNOs in order to be able to evaluate best practices and give guidelines in order to introduce standard solutions. It seems necessary a centralized coordination in order to exploit economies of scales and reduce transaction-costs.
The main improvement should be made having a long-term policy on connection charges; the objective would be to have a full account of the costs imposed to the system and its operations. Given the lack of information to impose deep charges could be a barrier for DG investors, an alternative method could be a system of shallow connection charges plus variable entry-exit charges. Entry charges can be used to give locational signal on connections costs and account for reduction in losses as a result of the use of DG; exit charges would compensate the costs of maintenance and operations and the difference between shallow and deep.
This method would be just a tool for costs allocation, which should be updated as long as more information is available on the effective costs of DG[17].
It is necessary to remind the importance of long term planning, for this reason DNOs should be supported in their investments on R&D and projects with an uncertain profits timeline.

[16] Recognizing local specific factors.
[17] We imply a socialization of part of the connection costs, which would compensate the general benefits brought by DG to the system. This percentage would decrease, as the quality of information about the system is refined allowing a correct allocation of costs and benefits.

For what concerns market integration, in this period there should be the beginning of specific market design rules in order to allow the participation of DG machines to the centralized exchange, possibly including ancillary services markets. In order to cope with the transaction costs problem there should be a legal framework to simplify the aggregation of producers through brokers.
In order to guarantee the transparency, there should be a precise definition of the degree of unbundling required for each activity. This is a process, which should be continuously updated as technical advances, especially in transferring and collection of data, change the set of strategies of each participant. This is an important point for Italy, since ENEL will control most of the DNOs until 2030, raising problem of horizontal and vertical integration; it is important to remind that also DNOs in large cities are vertically integrated[18]. The ownership of data on consumption (characterization of load) is a crucial fact for the development of DG; they are necessary to be able to figure out the customers, either at individuals or as a group, whose profile corresponds to specific technologies.

3.4.2 Stage 2010-2013

In this period the most meaningful change will be the full integration of DG to the market, which means including all the possibility offered by Demand Side Management. DG operators will have the necessary information to dynamically adjust their consumption/generation decisions to market conditions. Given the expected improvements in communication technology, DG should allow a better definition of consumers' preferences, also in terms of quality of service and security of supply.
It is expected also to begin to have long term signals to be used in order to expand the transmission network not with HV lines, but through DG machines installed in clearly defined high price areas.
During this period profitability of DG is expected to raise, the penetration will raise according to the number of customers, who will require high quality of service or will have flexible consumption patterns.
In the Table 3.1 we justified that the shift to IV-C is due to the market integration, which could occur even for a moderate percentage of DG in the system.
The regulation of networks will pursue the targets of the previous period, preparing for the change to active networks, which will depend on DG penetration.

3.4.3 Stage 2013-2020

We do not put a precise date for the beginning of the shift to active networks, since it depends on the realization of the demand according to multiple drivers and not only following indicators of economic growth.
The system at this stage would have no barriers for entrants as in the active network paradigm costs/benefits of DG could be fully recognized. DNOs will have a wider range of products than the simple transportation task; offering DSM, connection for DG and micro-grids; in the second case they will offer also reliability services. They should have a role of network optimizer given their superior information, which means that their knowledge should be used in order to facilitate coordination and not to be exploited in anti-competitive practices. It would be possible also to implement a sort of decentralization, giving the possibility to the DNO to organize locally balancing and the provision of ancillary services, which should be provided by DG.
The connection charges should be substantially deep and could be collected also as the mentioned method of shallow plus entry-exit charges, which would account for all the operational costs and network reinforcement incurred by the DNOs.

[18] We claim vertical integration even if firms follow the directive on unbumdling.

4 ROBUSTNESS OF THE REGULATORY ROAD MAP

In this section we will analyze the robustness of our roadmap under alternative conditions. Our work started with the definition of basic scenarios; as indicated in table 3.1 we proposed two basic parameters (DG & RES incentives and EU Harmonization policy) each with two degrees of intensity; out of the four combinations, we used scenario A for the roadmap, now we are interested to check the robustness of the roadmap under the other three possibilities B, C and D, which present less favourable characteristics for the penetration of DG.
In scenario B we have a lower level of support for DG and RES; the main effect would be a reduced pace of penetration and a general delay in market integration. The principle behind several Italian incentive programs is to support investors for a limited time, until fixed costs are recovered, then units should be able to compete with traditional technologies. In terms of DNOs innovation due to the reduction of investments in alternative technology will be more costly and possibly will never reach the state of active network management.
In scenario C we have a situation there would be a lower pressure for reforms at EU level combined with a strong policy of support at national level. This could possibly imply reduced competition due to a lack of control on a highly concentrated market and lack of clear guidelines on unbundling, which could prevent the transparency of operations of market participants[19].
This could affect the overall efficiency of the system with possible consequences on the Distribution/Supply sector, which could be less open to innovation and data exchange with customers. In terms of DG there could be a reduction of deployment especially if there would be barriers for DG operators to exploit all the market opportunities.
Scenario D would have a combination of the negative effect of B and C.

Table 4.1 - DG Scenarios

	High RES & DG incentives	Moderate RES & DG incentives
Stronger EU harmonization policy	<u>Scenario A</u> DG opportunities in a fully harmonized EU market • Efficient regulation (EU Regulator) • Market concentration • Non discriminating grid access rules • Ambitious EU-wide targets for RES & DG • Strong EU-wide support schemes (tradable certificates)	<u>Scenario B</u> Difficult times for DG in a fully harmonized EU market • Efficient regulation (EU Regulator) • Market concentration • Grid access rules disfavor small units • Harmonization of RES & DG support at a low level • EU wide certification schemes (tradable certificates)
Reduced EU harmonization policy	<u>Scenario C</u> DG opportunities in national markets • No harmonized regulation (national focus) • Some MS implement fair grid access • Ambitious EU-wide targets for RES & DG • Diversity of national support schemes • Strong RES & DG support compensates for regulatory deficits	<u>Scenario D</u> Difficult times for DG in national markets • No harmonized regulation (national focus) • No improvements in grid access • National support schemes partially reduced • No compensations for regulatory deficits

4.1 Disruptive Events

In the SUSTELNET project it has been decided to check the development of the roadmaps in case of specific disruptive events, which could alter substantially our results. These could be classified either as exceptional conditions or exogenous to the regulatory framework for DG.

There are three events selected at European Level:

- Fuel Cells Break Through
- Collapse of the Kyoto Process
- Gas Price Crisis

And two, which are considered at National Level:

- National Power Crisis/Security of Supply
- Reintroduction of Nuclear Plants

The collapse of the Kyoto process after 2010 will affect the expansion of DG, as there will be a lower pressure to achieve ambitious national targets. There is the possibility that the percentage deployed will not be sufficient to reach the final stage of the roadmap (switch to active networks).
The gas prices crisis should not reduce the profitability of DG as most of the system is based on Gas and import capacity is fully used, so there should not be significant competition from other sources.
The fuel cell breakthrough will increase the quantity of DG and accelerate the progression of the roadmap, favouring the decentralization of operations.
National Power Crisis: given the lack of reserve capacity and the blackouts of the summer of 2003 the system had already an example of power crisis. There are two effects: on one hand, a negative impact on DG, which is not considered a fast solution to solve the issue at national level. The government is concentrating his attention to authorize large investments in large generators, leaving DG as a long- term perspective. On the other hand individual consumers, who realize the risks for their activities of shortage of supply or price-spikes[20], start to consider DG as an interesting investment. It will take several years, at least after 2010 when the majority of new planned generation will be introduced, to understand the extent of this kind of issues in the Italian market and the possible use of the DG to face this kind of emergencies.
Given the threat of power crisis, there is an active debate on the possibility to introduce new Nuclear Power Plants after 2010, this could have a negative impact, due to a probable reduction of prices. The type of technology, which will suffer the most should be intermittent, since CHP, thanks to its flexibility to follow load, could still profit from the volatility of prices, which cannot be handled by nuclear sources.

[20] Tight reserve margin implies possible high prices.

5 ACTION PLAN

This section is meant to describe the role of each stakeholder, given the targets set in the roadmap. This exercise still cannot be fully developed in the present context, since as we mentioned the Italian system is under a phase of transition, which implies an uncertainty concerning the exact role of the institutions and the market participants.
Nonetheless we can summarize the various steps presented indicating the possible reference for their implementation.

Ministry of Industry/MAP (Ministero delle Attivita' Produttive)
The MAP is in charge of the energy policy and the market design. Clearly it has a huge influence on the development of DG, especially considering its joint actions with the Ministry of the Environment. The main role would be to support the process of network innovation and consequent increase of connection of DG units. It should also make sure of the adoption of fair rules in terms of markets access.

Regulator/AEEG
The role of the regulator will possibly evolve considerably over time; anyway in the implementation of the roadmap the main task will be to regulate both in economic and technical terms the access to the network and to give the correct incentives to the DNOs to shift towards the active networks objective. It is of primary importance a system of regulated distribution tariffs, which would recognize the importance of investments and would promote energy efficiency targets.

Distribution Network Operators
The DNO sector should directly carry the task of the system innovation; there is a need of a considerable shift in the type of business, which should be steered towards an increase in connectivity for new entrants. It is necessary to improve the exchange of information with customers and DG operators, in order to manage efficiently the network. Moreover the co-ordination between DNOs and the TSO should be improved.

DG Operators
They should closely interact with the DNO in order to exploit the intrinsic characteristics of DG in terms of support of the management of the network. They should operate actively in both the electricity and ancillary services markets.

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