Description of integrated pilots/demonstrations/field tests/existing practices

1. Name of the case: **Interruptibility service**

2. What is integrated with DSM

DG	X
Energy storage	
Smart grid technologies	

3. What is the level of commercialization

Research project	
Demonstration	
Field test	
Existing practice	X

4. Where to find more information?
   - Contact person: Susana Bañares Hernández
   - Company: Red Eléctrica de España
   - web-site: www.ree.es
   - references:

5. Objectives of the case

Allow the system operator to reduce electricity demand in certain parts of the grid, when the system security is at risk. The contracts are signed between the system operator and big consumers connected to the high-voltage grid.

6. Technologies used

Demand-side management, ICT technologies.

7. Short description of the case

When the system operator started to sign this kind of contracts with big electricity consumers, electricity supply was regulated in Spain. As a result, consumers who sign these contracts with the system operator receive electricity at a price which was cheaper than the regulated price that they would have paid unless they signed the contract. When electricity supply was liberalised, the former tariff structure remained in force, and these consumers did not change to competitive suppliers, because this contracts offered them better prices. However, regulated prices for high-voltage consumers will disappear in July 1, 2008, so no more reduction in regulated prices will be possible. Therefore, a new interruptibility service is now in force, according to which consumers can offer this service to the system operator, after signing a contract with him. Only consumers who are connected to high-voltage and who buy electricity at competitive prices can offer this service, as long as they are able to reduce 5 MW at any programming period (hour). There are different types of load interruptions, depending on which the payment for the service is higher or lower.

8. Achieved/expected results

Interruptible customers have historically helped the system operator manage emergency situations. Most of the times that customers have been asked to reduce their load there was a very high electricity demand, together with a shortage in electricity generation. For example, at the end of 2001, lack of available hydro capacity (as 2001 was a dry year), wind capacity (much less wind turbines were installed and the wind was not blowing in coldest days) and combined cycle power plants (most of them came on-line after 2002), together with a very cold winter put security of supply at risk, so the system operator asked these customers to reduce their electricity consumption.

Nevertheless, as wind power contribution to the system increased, interruptibility contracts offered a good way to enhance intermittent production integration. An example of this is the last time that interruptible customers were asked to reduce their consumption, on November 19, 2007. Expected electricity demand was high (about 43 GW), but such peaks had been met before without using load shedding, and even greater demand was met next month, without interruptibility. The problem was that wind stopped blowing, so there was not enough power production to meet demand and there was little time to put more power plants on-line, so interruptible customers were asked to reduce their electricity consumption.

9. Lessons learnt

This system has proved to be a good way to integrate both wind power and demand side management. Therefore, a new regulation came into force last year, according to which customers who own cogeneration plants can also provide this service, although they would only be used after the rest of interruptible customers were called. The system operator can ask cogeneration plant owners who sign this contract that they reduce their electricity consumption, while keeping their electricity production. Hence, this new regulation creates the environment for demand-side management and CHP integration.

If we take into account that interruptibility contracts proved to be effective for wind power integration, we can say that the new regulation allows for an integration of CHP generation, wind power and demand-side management.

Description of integrated pilots/demonstrations/field tests/existing practices

1. Name of the case: **Microgrid at Labein's facilities**

2. What is integrated with DSM

DG	X
Energy storage	X
Smart grid technologies	X

3. What is the level of commercialization

Research project	X
Demonstration	
Field test	
Existing practice	

4. Where to find more information?
   - Contact person: Jon Anduaga
   - Company: LABEIN
   - web-site: www.labein.es
   - references:

5. Objectives of the case

The main objective of this project is the research on the operation of DG equipment and micrograms (both connected and isolated from the grid). Other additional objectives are the following:

- Develop distribution grid models and microgrid equipment models (generators, storage…).
- Carry out experiments on the critical aspects for the exploitation of the micro-grid concept: requirements affecting both the electrical interface and the protection and control of each micro-generator; voltage control of the microgrid; power flow control; and load share in isolated mode. Once validated, control algorithms will be incorporated to microgenerator's controllers.
- Develop a microgrid energy manager optimizing the internal resources and allowing the microgrid integration in the actual and future electricity markets to obtain the maximum value.

6. Technologies used

Description of integrated pilots/demonstrations/field tests/existing practices

The microgrid consists of the following equipment:

- Generators: three types of photovoltaic installations (5,8 kW in total), two diesel generators (55kW each), a 6kW wind turbine, a 50kW microturbine
- Storage: 250 kVA flywheel, 6kW UPS based on ultracapacities, two battery banks (1080 Ah and 1925Ah)
- Network simulation: 110kW Grid simulator (perturbation generators), Distribution line simulator
- Loads: 2 x 36 kVA reactive loads, and 200kW (150kW + 50kW) resistive loads
- Microgrid configurator: permits the connection of generators and loads in different configurations
- Microgrid central controller: under development

7. Short description of the case

Along the last years, a microgrid has been set up at Labein's premises. The installation consists of distributed generation (DG) sources, loads, storage and grid simulators. It is located in Labein's company facilities and connected to its electricity grid.

8. Achieved/expected results

The Project is under development. However, some results have already been obtained:

- The microgrid was set up
- The network was simulated using the PSS/E program. The selected grid is the MV network to which LABEIN's facilities are connected. It is a quite representative distribution network and adequate to identify the problems that may arise due to the increasing levels of DG penetration in the grid.
- Control algorithms for inverters (master and multi-master configuration) have been designed and simulated. These control algorithms try to emulate the behaviour of big synchronous generators: P(f)-droop and Q(f)-droop characteristics.
- Apart from algorithms assuring the stability of the network (primary regulation), secondary regulation algorithms have also been implemented. These algorithms will be in charge of adapting the energy profile of the microgrid according to some specified generation plans (integration in the market and basis for the energy manager).

The following results are expected in the next months:

- A task regarding microgrid protections will deal mainly with the following two issues: anti-islanding protection and the grounding design. The protection algorithms will be integrated in a fast static switch.
- An economic model representing the microgrid resources will be developed, taking into account CHP technology. Based on this model, optimization will be applied to schedule the available resources in real-time.

9. Lessons learnt

Description of integrated pilots/demonstrations/field tests/existing practices

Description of integrated pilots/demonstrations/field tests/existing practices

1. Name of the case: **Technology Demonstration Centre" at San Agustin (Madrid)**

2. What is integrated with DSM

DG	X
Energy storage	X
Smart grid technologies	X

3. What is the level of commercialization

Research project	
Demonstration	X
Field test	
Existing practice	

4. Where to find more information?
   - Contact person: Iván Furones Fartos
   - Company: IBERINCO
   - web-site: www.iberinco.com
   - references: Dispower project

5. Objectives of the case

In the Dispower EU project a temporary measurement campaign was carried out to characterise the operation of the distributed components, the energy flows and power quality in the grid, and to study the dependence of the energy flow via the transformer from the generation of fluctuating generators (wind, PV).

The measurements were made during the period from 29th March 2004 to 2nd April 2004. The following scenarios and measuring periods regarding the operation of the distributed components were investigated:

- 1. Wind turbine without other generators or loads,
- 2. Wind turbine and PV without other generators or loads,
- 3. Maximum consumption without generation,
- 4. Maximum consumption and wind turbine without other generators,

- 5. 27 kWp PV generator, 2*1 kWp solar roofs and wind turbine without loads,
- 6. Connection of the diesel generators.

To assess the voltage quality according to EN 50160, the following parameters were investigated in detail as part of this analysis:
1. Voltage level and symmetry,
2. Relation between voltage level and effective power,
3. Long-term flicker,
4. THD – U and harmonics.

6. Technologies used

The microgrid consists of the following equipment:

- Generators: Two asynchronous diesel generators (20kVA 3-phase, 8 kVA one phasig), one synchronous diesel generator (1100 kVA), 10 kW windmill, 27 kWp photovoltaic plant
- Storage: one Battery bank

7. Short description of the case

The Technology Demonstration Centre (TDC) at San Agustín, near Madrid, is an essential support element for the activities carried out in the Power Generation Division of Iberdrola.

8. Achieved/expected results

Permissible voltage limits, according to EN 50160, were observed with the exception of some measurement periods, where the voltage value at the wind turbine node fell below the lower limit (207 V). It can be concluded that the chosen operating grid voltage of 210 V is too low. As the voltage did not even approach the upper limit during any of the measurement periods, it is proposed that the rated voltage should be raised to a value of at least 220 V. The voltage level is affected by the generators with higher power ratings (PV systems) and by fluctuations on the medium-voltage side of the transformer.

Asymmetric effects for voltage are caused by non-uniform distribution of the loads and inverters which feed into single phases. Consequently, the voltage asymmetry could be reduced by distributing these components more uniformly over the three phases. On the other hand, analysis revealed that the phase voltages are already asymmetrical on the medium-voltage side of the transformer.

It was demonstrated that the effective power supplied to the grid has a direct effect on the voltage level in the grid. If the supplied power is higher than the simultaneous consumption, the general voltage level rises, whereas it falls for the opposite case. The measured long-term flicker intensity was non-critical throughout the entire measurement period according to EN 50160.

Description of integrated pilots/demonstrations/field tests/existing practices

The voltage distortion (THD-U) is non-critical for all operating situations according to EN 50160. Comparison of individual measurement periods showed the effect of certain devices on the level of individual harmonics. It was demonstrated that the inverters significantly raised the level of orders higher than the 14th. As a result, the values in some phases at both nodes are either only just below or even higher than the limits specified by EN 50160. The loads present in the grid contribute essentially only to the harmonics of the 3rd, 5th and 7th order.

At the time when the loading on the transformer was highest (65 kW during supply), an effective power of around 70 kVA was measured. The transformer (rated power of 100 kVA) was thus operating at 70 % of full load. However, it should be noted that during the entire measurement period neither the two diesel generators, with a total of 28 kVA, were supplying power, nor were the PV systems operating at peak power due to the low level of solar radiation. Assuming that these components also supplied maximum power, the transformer could be overloaded if the generated power is high and the consumption is low.

9. Lessons learnt

See point 8.

Description of integrated pilots/demonstrations/field tests/existing practices

1. Name of the case: **Fenix EU project Southern Scenario**

2. What is integrated with DSM

DG	X
Energy storage	X
Smart grid technologies	X

3. What is the level of commercialization

Research project	X
Demonstration	
Field test	
Existing practice	

4. Where to find more information?
   - Contact person: J. Oyarzabal
   - Company: LABEIN
   - web-site: www.labein.es
   - references:

5. Objectives of the case

The general objectives defined for the Southern Scenario Demonstrator address the participation of distributed generation through the Virtual Power Plant concept into the power system operation in the wide sense. Therefore, market processes such as day ahead energy pool or tertiary reserve markets are part of the scenario but real time operation and network management are also included.

Several targets are defined for this purpose, in summary:

A) Providing global services (TSO level)
   - a.1) Selling energy: Integration in the day ahead market process
   - a.2) Tertiary reserve: Balancing market
   - a.3) Selling reactive power capacity

B) Providing local services (DSO level)

b.1) Help maintaining voltages in lines

b.2) Use active power generation to avoid load shedding and help keeping supply in local constrains. (This target will be proved through simulations)

6. Technologies used

The province of Alava has no conventional generation power plants; all of them belong to the special regime category. There are several renewable technologies (two wind parks among them) and large CHP units representing a total installed capacity in the range of 170 MVA, which means about a 35% of the transformers capacity linking transmission and distribution networks.

There are several types of renewable and non renewable power plants, distributed along several circuits and connected at different points: close to the substation, middle and end.

One outstanding fact of some CHP units is that, although there are industrial processes running and requiring the heat load, they are capable of providing some control margin over the active power production.

7. Short description of the case

Fenix project's field test demonstration is divided in Northern and Southern scenario following the differences in electricity market design and participant DER size. In brief, northern scenario focuses on balancing responsible parties and small scale DER resources including flexible demand connected to low voltage networks, while southern scenario targets medium size DER and medium voltage networks.

An area of Iberdrola's network (corresponding to the province of Alava) has been selected, with the scope of managing it, including the connected DER, from two points of view: technically and economically (at the market). Although real test will be carried out for the technical part, simulation will be used for the analysis of economic aspects.

In every case DSO and TSO should validate feasibility in the proposed solutions: n-1, quality of service (±7% voltage) and overloads.

The project is still ongoing.

8. Achieved/expected results

9. Lessons learnt

Description of integrated pilots/demonstrations/field tests/existing practices

1. Name of the case: **MICRORRED project Rural Microgrid**

2. What is integrated with DSM

DG	X
Energy storage	X
Smart grid technologies	X

3. What is the level of commercialization

Research project	X
Demonstration	
Field test	
Existing practice	

4. Where to find more information?
   - Contact person: Sabino Elorduizapatarietxe
   - Company: ROBOTIKER
   - web-site: www.robotiker.es
   - references:

5. Objectives of the case

The objective of the project is the installation, test and assessment of a microgrid-set in a rural environment connected to the distribution network. The aim of the microgrid is to guarantee the electrical supply in isolated and week grid areas.

6. Technologies used

- Generators: Photovoltaic installation (around 5,5kWp), small wind turbine (1,5 kW), asynchronous diesel generator (around 6 kW), PEM Fuel Cell (2,5 kW)
- Storage: battery set
- Others: microgrid control system, multilevel converter for battery management and grid generation in microgrid isolated mode
- Loads will be managed though a contactor (not critical loads buy all loads).

7. Short description of the case

A microgrid will be designed, built and connected to an end of Iberdrola's distribution network. It will be located in a rural area in the province of Burgos, Spain. After the installation will be connected, operation tests will be carried out for, at least, one year.

The microgrid will be able to work either isolated from the grid or connected to it. Both standard and developed equipment will be used. Seven partners including a DSO, manufacturers, engineering companies and research centres participate in the project.

When connected to the distribution grid only renewable energy based generators will be deployed. On the contrary, when isolated from the grid all generators will be available and utilised according to the demand.

A Farm, which consists of three houses, a workshop and warehouses, will hold the microgrid.

The project is still ongoing.

8. Achieved/expected results

The main result to be achieved is the correct operation of the microgrid. The microgrid should be able to balance demand and generation in every moment when working in isolated mode. It should be able to detect failures in the grid and switch automatically to isolated mode. In the same way, it should connect again to the network when voltage is restored.

The prototypes developed by partners should be tested and their operation proved correct.

9. Lessons learnt

Description of integrated pilots/demonstrations/field tests/existing practices

1. Name of the case: **Acciona Solar Building**

2. What is integrated with DSM

DG	X
Energy storage	
Smart grid technologies	X

3. What is the level of commercialization

Research project	
Demonstration	
Field test	
Existing practice	X

4. Where to find more information?
   - Contact person:
   - Company: ACCIONA SOLAR
   - web-site: www.aesol.es
   - references:

5. Objectives of the case

Demand reduction, sustainability, image of the company

6. Technologies used

Demand reduction: the building has been designed using simulation tools with the scope of preventing equipment over-sizing; light regulators have been installed to take profit of natural light and of the needs and use of the space.

Energy Efficiency: air conditioning ancillary boiler uses biodiesel and recovers condensation heat; radiant floors and ceilings for heat and cold distribution; energy recovery at the ventilation system; intelligent control of air conditioning and heating

Renewable energies: 170 m^2 solar thermal roof; solar PV installation (19,2 KW_p) in the roof and in the façade (31,2 kW); biodiesel condensation boiler plus two absorption chillers;

Description of integrated pilots/demonstrations/field tests/existing practices

7. Short description of the case

Acciona Solar is a company dedicated to projects and installations dealing with renewable energies.

The new site of "Acciona Solar" in Sarriguren (Navarre) is a bioclimatic self-supplied building: energy production equals demand.

8. Achieved/expected results

It is expected that the energetic balance of the building will be zero.

9. Lessons learnt

Description of integrated pilots/demonstrations/field tests/existing practices

1. Name of the case: **EREN building**

2. What is integrated with DSM

DG	X
Energy storage	
Smart grid technologies	X

3. What is the level of commercialization

Research project	
Demonstration	X
Field test	
Existing practice	X

4. Where to find more information?
   - Contact person:
   - Company: EREN
   - web-site: www.eren.jcyl.es
   - references:

5. Objectives of the case

Demand reduction, sustainability, demonstration of bioclimatic architecture and energy efficiency.

6. Technologies used

Solar thermal and PV installations are installed in roof and façade.

For heat generation, both a high efficiency boiler and a micro-cogenerator are used.

Energy recovering is used for heat and cold systems.

A domotic control system is used and remote management of the HVAC system is possible.

7. Short description of the case

Description of integrated pilots/demonstrations/field tests/existing practices

Since 2002, EREN building is an example of bioclimatic building with high energy efficiency. It is located in the town of Leon.

EREN is a regional energy agency in Castilla-Leon.

8. Achieved/expected results

The building consumes 50% of the energy of that of an equivalent conventional building. In terms of electricity the savings amount 30%.

9. Lessons learnt

Description of integrated pilots/demonstrations/field tests/existing practices

1. Name of the case: **Bolueta neighbourhood project**

2. What is integrated with DSM

DG	X
Energy storage	
Smart grid technologies	

3. What is the level of commercialization

Research project	
Demonstration	X
Field test	
Existing practice	

4. Where to find more information?
   - Contact person:
   - Company: Bilbao Municipality
   - web-site: www.bilbao.net
   - references:

5. Objectives of the case

Create an urbanized area able to generate the energy that it demands.

6. Technologies used

A cogeneration plant will supply the buildings in the neighbourhood with heat. In addition, solar (thermal and PV), wind and hydraulic energy (small hydro - an old plant will be recovered) will be used.

7. Short description of the case

This project seeks to build and environmentally friendly neighbourhood in Bilbao. 1.100 dwellings will be built in the area.

Description of integrated pilots/demonstrations/field tests/existing practices

The project is designed but its beginning has been delayed many times due to different reasons.

8. Achieved/expected results

9. Lessons learnt

Description of integrated pilots/demonstrations/field tests/existing practices

1. Name of the case: **RES_2H_2**

2. What is integrated with DSM

DG	X
Energy storage	X
Smart grid technologies	

3. What is the level of commercialization

Research project	X
Demonstration	X
Field test	
Existing practice	

4. Where to find more information?
   - Contact person: Salvador Suarez
   - Company: Instituto Tecnológico de Canarias (ITC)
   - web-site: www.itccanarias.org
   - references:

5. Objectives of the case

The objective of Project RES2H2 is to prove that clean production of hydrogen is feasible at industrial level, and that the problem of temporary energy storage that is usually inherent in many renewable energy sources, can likewise be overcome. Therefore, the integration of renewable energy sources with the recently promoted "hydrogen vector" is what is being presented through this European project.

6. Technologies used

The system consists of the following main equipment:

- Wind turbine: 225kW
- Electrolyser (40 kW)
- Hydrogen storage tank and purifier
- 30 kW Fuel Cell
- 40 kW Desalination plant (reverse osmosis)

Description of integrated pilots/demonstrations/field tests/existing practices

7. Short description of the case

The system is thought to work islanded from the grid. The wind mill generates hydrogen by means of the electrolyser and the excess of electricity that can not be converted to hydrogen is used to desalinate sea water. The Fuel cell would supply 30 kW electricity to consumers.

8. Achieved/expected results

Prove the clean production of the hydrogen.

9. Lessons learnt

Description of integrated pilots/demonstrations/field tests/existing practices

1. Name of the case: **Antondegi neighbourhood project**
2. What is integrated with DSM

DG	X
Energy storage	
Smart grid technologies	X

3. What is the level of commercialization

Research project	
Demonstration	X
Field test	
Existing practice	X

4. Where to find more information?
   - Contact person:
   - Company: EVE, VISESA
   - web-site: www.eve.es, www.visesa.com
   - references:

5. Objectives of the case

Build an urban area under the following criteria: energy efficiency, renewable energy use and sustainability.

6. Technologies used

Solar thermal panels will be installed in all buildings for the generation of hot sanitary water. Photovoltaic panels will be installed in roofs, street lamp-posts… Small wind turbines will be integrated in the urban landscape. A biomass boiler will be installed: it will use wood wastes. It is expected that 13% of the energy consumption will be covered by renewable energies. The rest of the demanded energy will be provided by a centralised communication system of about 4 MW.

In addition, buildings will use passive energy solutions achieving 40% energy save rates.

Monitoring systems in each dwelling will inform people about their consumption in any time: hot water, heating and electricity. The communications will be sent to the monitors by means of PLC systems.

7. Short description of the case

4.030 dwellings will be built in this area of the city of Donostia-San Sebastián. The energy efficiency measures and the energy generation systems will permit that area can generate the energy that it demands.

The total expected reduction in energy consumption is 29%.

The project is co-financed by the EU CONCERTO programme and currently it is at the first stages of construction.

8. Achieved/expected results

Create an urbanized area able to generate the energy that it demands.

The people living in this place should feel proud and take part in a life-quality improvement project and environmental impact reduction.

9. Lessons learnt

Description of integrated pilots/demonstrations/field tests/existing practices

1. Name of the case: **Sarriguren eco-city**

2. What is integrated with DSM

DG	X
Energy storage	
Smart grid technologies	

3. What is the level of commercialization

Research project	
Demonstration	
Field test	
Existing practice	X

4. Where to find more information?
   - Contact person:
   - Company: NASURSA (Navarra de Suelo Residencial S.A.)
   - web-site: www.navarra.es, www.nasursa.es
   - references:

5. Objectives of the case

Develop a residential area gathering the basic concepts of sustainable development: balance between economic progress, welfare and environment.

6. Technologies used

The use of renewable energies was foreseen, among them: thermal solar panels in buildings (this has been already implemented), wind energy, hydraulic energy and biomass production. No information has been found about the real installation of these energy systems.

7. Short description of the case

This is an initiative promoted by the Environment, territory ordination and housing Department of the region of Navarre. It started back in 2000 and it is under the final state of completion. People are already leaving in the "phase I" 5.217 new built dwellings since 2005. The second phase amounts 3.232 more dwellings. There are seven different types of residential constructions.

46,8% of the surface it is dedicated to pedestrians.

General characteristics: bioclimatic architecture and energy efficiency; urban environment improvement (physical, economical and social); efficient use and generation of energy; energy demand reduction, renewable energies and recycling; preservation, utilisation and management of natural areas in urban environment; and integration of transport infrastructures and environmental impact reduction.

8. Achieved/expected results

Help to solve the existing housing access problems; create a demonstration eco-city that may have an impact on the society; promote a big scale experience of energy savings and renewable energy integration; and create a diverse urban community by the integration of residential use and innovation activities.

9. Lessons learnt