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Sustainable NOW Energy and Emissions Monitoring Report:

Energy and Emissions Monitoring before and after Sustainable NOW

Contents:

1. **Introduction**
2. **Energy and Emissions Monitoring: Sustainable NOW Support**
3. **Focus on Germany**
4. **Focus on Italy**
5. **Other Sustainable NOW City Partners.**
6. **Conclusions**
7. **Further Reading**

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1. Introduction

1.1 The Sustainable NOW project approach emphasised the need for actions at a city level which were measurable. City partners were encouraged to ensure that all of the projects, initiatives and actions that were taken were measurable in terms of their energy savings, use of renewable energy and their contribution to emissions reductions.

1.2 Deliverable D4.3 has challenged city partners to implement detailed and credible monitoring of their energy initiatives. A selection of city partners was invited to contribute to this report, which seeks to demonstrate the achievement of the deliverable during Sustainable NOW. City partners from Germany and Italy were asked to describe their position in the context of their energy targets, to describe the impact of their most significant energy initiatives, and to review their position now that the Sustainable NOW project has been completed.

1.3 This report presents results from city partners from Germany and Italy. This provides an opportunity to compare approaches to achieving measurable results within each country, and between different countries. The report does not cover the full detail of the initiatives that the city partners have implemented. Therefore some links to further reading are presented at the end of the report.

2. Energy and Emissions Monitoring: Sustainable NOW Support

2.1 The Sustainable NOW project sought to support all city partners in their delivery of energy projects and initiatives, to promote sound implementation and monitoring. It was recognised that there was no standardised approach across Europe for measuring the impact (quantitative) of energy projects, but there were a number of methods and tools that were either available or emerging. There were resources allocated within the project that sought to support the city partners towards the adoption of a suitable means to monitor their energy projects, that would capture quantitative data for energy and emissions reductions, along with renewable energy generation.

2.2 The Sustainable NOW project meetings introduced monitoring methodologies that had been developed by a range of institutions that enabled energy initiatives to be monitored on a project by project basis. Some city partners were already following particular processes, whilst some partners were seeking to adopt a

recognised methodology for the first time. The project meetings and numerous other interactions enabled the partners to understand a range of options, and discuss their applicability with other city partners.

2.3 Sustainable NOW established a series of 'twin partnerships' whereby city partners were paired together for a detailed learning exchange. The subsequent study tours and information exchanges enabled cities to examine monitoring regimes that were used in their twin cities. The twin partners were selected based on geographic and situational synergies, meaning that there was a good chance that practices could be applicable to the both partners.

2.4 Two CO_2 monitoring workshops (hosted in Siena and Freiburg) were delivered within the Sustainable NOW project plan. Each comprised a day-long workshop for city partners to learn in detail about monitoring options and to consider their approach based on discussions about their situations. ICLEI and Climate Alliance, as project partners, presented a range of options for the consideration of city partners:

- A methodology for implementing a Greenhouse Gas Inventory in the context of Local Energy Action Plans, based on ICLEI's Greenhouse Gas Inventory toolkit and the ECO Region tool.
- A detailed explanation of the Covenant of Mayors monitoring methodology as a standardised tool for monitoring energy and emissions reductions across Europe.
- A review of the methodologies advocated by the Intergovernmental Panel on Climate Change, spanning scope, boundaries and conversion factors.
- A review of the specific municipality-focussed International Local Government Emissions Analysis Protocol (http://www.iclei.org/ghgprotocol)

2.5 Sustainable NOW presented the city partners with an opportunity to consider and evaluate monitoring possibilities. For some partners, this was a chance to consider the effectiveness of their existing regimes. For other partners it was the chance to adopt a formal monitoring process for the first time. Sustainable NOW provided partners with an opportunity to make informed decisions about their monitoring approach. This opportunity is available to other European Cities through the online project resources that are accessible through the Sustainable NOW web site.

3. Focus on Germany

3.1 **German City Partners**

Munich and Ludwigsburg are two Sustainable NOW City Partners from Germany. Climate protection was already a key issue for Germany prior to the commencement of Sustainable NOW. Ludwigsburg was advanced in its approach to issues such as Local Agenda 21, but needed to formalise its approach to energy management through development of a Local Energy Action Plan. Munich had a history of action including a 1991 resolution to cut CO_2 emissions by 30% by 2005, and by 50% by 2010. Energy saving and renewable energies were seen as key requirements by both cities.

3.2 **Position before Sustainable NOW**

In the spring 2007 Germany held the EU Presidency and encouraged the European Council heads of state and government to set parameters for an integrated European climate and energy policy. The German federal government was strongly moving towards ambitious climate protection targets (40% CO_2 reduction by 2020 compared to 1990), as well as the expansion of renewable energy use and increases in energy efficiency. The government had announced 30 individual measures in the package that addressed integrated energy and climate protection, with guiding principles comprising security of supply, economic efficiency and environmental protection. Under the agreements of the Cabinet in Meseberg the programme was adopted by the Cabinet as a legislative package and introduced into the *Bundestag* before the climate change conference in Bali in December 2007.

3.3 **Relevant targets for Germany**

There are a range of national energy and emissions targets that are relevant to German cities, and provide a context for the efforts of Munich and Ludwigsburg:

- Kyoto: Reduction of CO_2 emissions by 21 % by 2012 (base year 1990).
- Reduction of green house gas emissions by 40 % by 2020, by 55 % by 2030, by 70 % by 2040, by 80 – 95 % by 2050 (compared to 1990).
- Doubling of energy productivity (efficiency) by 2020 (base year 1990).
- Increase green electricity market share to 30 % by 2020, then to reach 50 % by 2030.
- Enhance percentage of renewable energies in power supply by 12.5 % by 2010 (already exceeded in 2007). Reference EEG 2008.
- Since EEG 2009: Enhance percentage of renewable energies in power supply by 30 % by 2020. Continuous enhancement target which would reach about 50 % of renewable energies in power supply in 2050.
- Enhance percentage of renewable energies in heat consumption by 14 % by 2020.
- Total percentage of bio-fuels is to increase by 6.25 % from 2010 until 2014 related to the total fuel consumption. This leads to an energetic percentage of 12 % of bio fuels related to the total fuel consumption in 2020.
- Provide 18 % of Germany's consumption of end-use energy (power, heat, fuels) from renewable energies by 2020. Continuous enhancement: 30 % in 2030, 45 % in 2040, 60 % in 2050 (EEG 2009).

3.4 **Monitoring before Sustainable NOW**

Ludwigsburg monitored CO_2 emissions, energy efficiency and Renewable Energy just for the city owned buildings and for street lighting. The city had no information about CO_2 emissions for the whole city or for total energy used. In the City Development Concept "Perspectives for Ludwigsburg" the strategic objective "development of an energy concept" was already determined. Munich had already implemented a range of regular internal monitoring processes. Energy efficiency and renewable energy monitoring regarding the municipal real estate (including rented buildings) was being undertaken.

3.5 **Measures undertaken and measured impacts**

A selection of initiatives undertaken by Munich and Ludwigsburg are now presented to provide an indication of the types of projects that have been proven as successful through monitoring.

3.5.1 **Hydro power in Munich**
Together with Green City Energy, Munich built a hydro power plant in the river bed of Munich's Isar. It generates 10 million kilowatt hours of green electricity per year, enough for 4,000 Munich households. Carbon dioxide reduction overall: 9,000 tons per year.

3.5.2 **CHP in Ludwigsburg**
Since 2009 the CHP biomass-power plant of the gas and water works Stadtwerke Ludwigsburg-Kornwestheim has been operational (48 Million kWh/yr heating, 10 Million kWh/yr electricity). It is saving 20.000 tonnes CO_2 per year.

3.5.3 **Solar technology in Munich**
The large-scale solar power plant in Rothenburg/Oberlausitz is going on the network with a capacity of 20 MWh. The joint project of Gehrlicher Solar AG (share - 60 percent) and the City of Munich (share - 40 percent) provides around 8,000 households overall with green electricity and saves around 18,000 tonnes of CO_2 per year. Since December of 2008, a thin-film solar plant with a 10-megawatt capacity produces green electricity in Lauingen/Donau. This joint project of Munich with Gehrlicher Solar AG (Munich share 49.9 percent) supplies approximately 4,000 households. Carbon dioxide reduction overall: 8,800 tonnes per year.

3.5.4 **Photovoltaics in Ludwigsburg**
Some large scale photovoltaic plants on roofs of 18 city owned buildings were realised in partnership with citizens, coordinated by the Solarinitiative Ludwigsburg. They have a capacity of 530 kWh.

3.5.5 **Geothermal Energy in Munich**
Starting in 2011, a geothermal cogeneration plant of Munich in Sauerlach will generate electricity for 16,000 households and at the same time, provide heat for Sauerlach households. Carbon dioxide reduction: 35,000 tonnes per year.

3.5.6 **District Heating Grid in Munich**
In recent years Munich has systematically converted its district heating system to more efficient combined heat and power generation systems (CHPs) which meanwhile account for over 80 % of the district heating supply. Using waste heat from electricity generation for district heating, Munich was able to save around 4 billion kilowatt-hours of heating energy in 2000. This corresponds to the annual consumption of 150,000 family households and a good 400 million liters of fuel oil respectively, which were not burnt to the detriment of the environment. Therefore M-Fernwärme makes an enormous contribution to the clean air in Munich.

3.5.7 **Sustainable homes in Ludwigsburg**
The new residential area Hartenecker Höhe for around 1.600 inhabitants was developed on the area of a former barracks and has a size of 18 Hectares. The buildings are of a very high energy standard and connected to the district heating system supplied by the biomass-power plant. A district heating system in the new residential area "Am Sonnenberg" for around 750 inhabitants is supplied by geothermal power combined with CHP.

3.5.8 **Off shore wind energy for Munich**
Recently Munich and its partners have acquired 9 wind farms in Havelland with 83 turbines. Munich is the majority shareholder with 75 percent. Its share of 236 million kilowatt-hours per year corresponds to the annual consumption of approximately 95,000 Munich households. Carbon dioxide reduction overall: 280,000 tonnes per year.

3.6 **Position after Sustainable NOW for Munich**
For Munich, Sustainable NOW represented a synergy project. Shortly after the project start, the Mayor signed the Covenant of Mayors convention and obliged firstly to design and implement a Sustainable Energy Action Plan (known as Local Energy Action Plan within Sustainable NOW), secondly to update regular CO_2 emissions inventories (which had been in place for several years). Sustainable NOW allowed for an intense exchange of experience between more or less equal and different European partners in the fields of energy and CO_2 balance preparation, accompanied by very helpful technical assistance. For the city of Munich, this meant a fruitful check and review of management regimes and planned activities

3.7 **Position after Sustainable NOW for Ludwigsburg**
During the Sustainable NOW project, the Ludwigsburg Local Energy Action Plan, titled “Gesamtenergiekonzept” was developed. At the beginning of 2011 it was finalised: an energy concept for the whole urban area. It was developed in cooperation with the University of Stuttgart and local experts like the Ludwigsburg Energy Agency. The concept contains a review of energy supply and consumption (using a baseline of 2007), scenarios, energy objectives and measures to reach them. There were 25 actions recommended by the University in areas such as heating, electricity, renewable technologies, mobility and overall measures. The next step will be to implement them in future years. The CO_2 emissions in Ludwigsburg in 2007 were totally 592,000 tonnes CO_2 per year. The energy related CO_2 emissions according to energy carriers shows that liquid fuels are accountable for a share of 28% and fuel oil for a share of 29%. Natural gas follows with a share of 20% and electricity with a share of 18%. Attributing the CO_2 emissions resulting from generating the district heating to the consumption of district heating yields a share of 4.4%. The CO_2 emissions in Ludwigsburg were reduced even further with the commencement of a wood chip power plant operation. This measure alone reduced the emissions by 18,000 tonnes such that the emissions level achieved was 521,000 tonnes CO_2 per year and around 6.0 tonnes CO_2 per capita per year. This is below the average in Germany and Baden-Württemberg. The city hopes to achieve more CO_2 reduction beyond the national targets for Germany.

4. Focus on Italy

4.1 **Italian City Partners**
There were four Italian Sustainable NOW City Partners. Siena, a province of 36 municipalities has responsibility for environmental protection and local resource management across the Province. Siena came to the project with an energy plan for the province already in place, and delivering benefits against a comprehensive set of actions. Bologna was a second partner that had significant experience of

energy management and monitoring within it's territory, and was seen as a leading city in Italy for it's advanced approaches. Rosignano Marittimo was a project partner with some experiences of implementing local energy actions but was anxious to develop a suitable plan to ensure strong implementation and monitoring. The Municipalities Association for the Trasimeno region was the fourth Italian partner, facing particular challenges of implementing a Local Energy Action across some particularly unique rural communities.

4.2. **Position before Sustainable NOW**

Climate protection had become a national priority. The role of local governments has been recognised as an important element to improve local resilience. In this context the Local Agenda 21 programme was supporting actions as it had gathered momentum in Italy, and was contributing to widespread dissemination, with a focus on local stakeholder involvement and participatory processes.

4.3 **Relevant targets for Italy**

The main targets that were presenting as drivers for local energy action in Italy included:

- The national target for greenhouse gas emission reduction was derived from Kyoto protocol target: 8.5 % reduction against the 1990 level.
- The national target for renewable energy is to achieve 17% of national energy requirements, in line with the European guidelines: this is the objective of National Action Plan for renewable energy, developed by the Ministry of Economic Development, in accordance with the provisions of Directive 2009/28/EC.
- A further Italian national target for 2020, is to increase energy efficiency by 20%.
- The national targets have not changed during the Sustainable NOW project (2008-2011).

4.4. **Monitoring before Sustainable NOW**

Bologna had implemented a 'Municipal Energy Program' which included monitoring regimes to measure the city's position against the Kyoto targets. Siena had developed detailed monitoring of energy and emissions reductions and renewable energy savings through 'Project Carbon Free 2015'. Rosignano Marittimo had developed 'Project Energy' which set out some specific energy improvement projects, although the intention was to develop the monitoring approach during Sustainable NOW. The Municipalities Association for the Trasimeno region also intended to develop comprehensive monitoring during Sustainable NOW.

4.5 **Measures undertaken and measured impacts**

The Italian partners had undertaken a range of initiatives with some clear, tangible outcomes to show. Below, a selection of projects from the partners is described briefly.

4.51. **Use of Solar Thermal technology in Bologna**

A range of individual solar thermal installations have delivered clear, measurable outcomes for the city. The installation of solar thermal systems in two municipal schools resulted in production of 124 MWh/yr of hot water, resulting in emissions reductions of 25 tonnes CO_2 per year. Installation of 102 m^2 of a solar thermal

system in a municipal swimming pool generated thermal production equal to 60 MWh/yr.

4.5.2 **Photovoltaics for schools in Rosignano Marittimo**
A set of 02.12 kWh of PV panels was installed on public schools; these plants produce 44% of the electricity needs of those schools, reducing the emissions of 94.5 tonnes per year of CO_2.

4.5.3 **Renewable Energy Development programme in Siena**
The Province of Siena has recognised the role of a range of renewable energy technologies that will be needed to deliver the aims of 'Carbon Free 2015'. There are realistic targets set for 2015 based on achievements measured between 2007 and 2010. During that period, photovoltaic installations increased from 0.1 MWh/yr to 5.1 MWh/yr. Geothermal installations increased from 188 MWh/yr to 228 MWh/yr, whilst biomass installations increased from 1 MWh/yr to 12.5 MWh/yr.

4.5.4 **Adoption of solar installations by Municipalities Association for Trasimeno**
The association has measured the contribution of solar technologies that have been installed across the thirteen municipalities. 8,277 kWh/yr is being generated across 431 installations that have been implemented across public and private properties and buildings.

4.5.5 **Housing stock improvements in Bologna**
Upgrading the energy efficiency of residential buildings to ensure compliance with more stringent performance standards has led to reduction of energy consumption in residential sector. The estimated savings are equal to 56,850 MWh/yr of natural gas. Meanwhile upgrades to the energy efficiency of social housing to include insulation and energy efficiency measures have delivered estimated savings equal to 2670 MWh/year.

4.5.6 **Landfill efficiency improvements in Rosignano Marittimo**
The municipality was able to improve efficiency of the landfill, both in the capture of biogas and in the production of renewable energy. This improvement has decreased emissions from landfill by 8%.

4.5.7 **Energy efficiency on real estate in the Province of Siena**
Siena Province's energy audit on its real estate (400,000 m^2) tackled monitoring data on energy and water consumption, transformer energy efficiency analysis and energy resources use analysis. An example of a specific outcome was an incentive programme to realise photovoltaic plants (up to 20 kWh) in the whole Sienese territory funded by 1,800,000 Euros, with 3,443 kWh/yr generation.

4.5.8 **Streetscene projects in Bologna**
Energy efficiency measures on traffic lights and public lighting involved the replacement of incandescent lamps with LED lamps. The estimated savings are equal to 2445 MWh/yr of electricity. The refurbishment of a municipal car park has provided for a decrease in the number of vehicles through reduced parking capacity and switch to natural gas or LPG instead of gasoline. The estimated savings are 413 MWh/yr of gasoline and 158 MWh/yr of natural gas.

4.6 **Position after Sustainable NOW for Bologna**
Sustainable NOW provided a useful contribution to the updating of the inventory of emissions and to the realisation of the first draft of the Sustainable Energy Action Plan (SEAP) planned for the Covenant of Mayors. Now, the municipality is performing well against targets derived from the Local Energy Action Plan (now included within the SEAP). Bologna is involving different sectors and local stakeholders to identify appropriate instruments for monitoring and to evaluate existing tools. The activation of the most current set of monitoring tools will be complete by December 2011.

4.7 **Position after Sustainable NOW for Siena**
The project has helped Siena to develop the 'Carbon Free 2015' brand and programme. The brand will be applied to actions to develop projects using renewable energy sources and actions to reduce energy from fossil sources. This will be backed up by monitoring regimes that have been verified as fit for purpose through the Sustainable NOW project.

4.8 **Position after Sustainable NOW for Rosignano Marittimo**
The most important result achieved by the Municipality of Rosignano at the end of Sustainable NOW, was the development of the Local Energy Action Plan, thanks to the collaboration of other city and technical partners and with the Energy Agency of Livorno Province. The energy plan is the starting point for future, measurable improvement actions.

4.9 **Position after Sustainable NOW for Municipalities Association for Trasimeno**
The association has benefited from learning opportunities and mentoring provided within Sustainable NOW. The association can now deliver improvements that can be measured against a comprehensive baseline emissions inventory for all territories. The presence of an approved Local Energy Action Plan and cooperation with the municipalities sets a clear framework for achieving energy and emissions reductions.

5. Other Sustainable NOW City Partners

5.1 City Partners from **Burgas (Bulgaria)**, **Miskolc (Hungary)** and **Woking (England)** have received support and mentoring through Sustainable NOW that has been equal to the German and Italian cities described in this report. Details about the projects of these partners can be viewed on the Sustainable NOW project web site, where the Local Energy Action Plans of the five 'learning' cities (Burgas, Comunita Montana Lago Trasimeno, Ludwigsburg, Miskolc and Rosignano Marittimo) can also be downloaded.

5.2 The municipality of **Burgas** includes private investments for wind and solar electricity plants with a total capacity 150 kWh. Energy saved from measures applied to 5 educational institutions is 1208.53 MWh/yr. Another 5 municipal buildings where energy efficiency measures were applied with municipal budget resulted in savings of 273.23 MWh/yr. There is data for CO_2 reduction on 9 municipal buildings where energy efficient measures such as insulation and replacement of windows have been applied. Total reduction is estimated at 483.26 tonnes CO_2 per year.

5.3 The city of **Miskolc** has continued a successful programme of insulation and refurbishment of prefabricated residential flats which is delivering impressive energy and CO_2 reductions. Other major infrastructure projects include a landfill gas plant which has been completed which will reduce emissions and improve energy capture from municipal waste. Heating bricks will be produced from waste products.

5.4 In England, **Woking** Borough Council have installed Combined Heat and Power infrastructure to provide for the energy requirements of municipal buildings, and for some private customers through its Energy Services Company and private electricity network. The Council continues to monitor emissions according to national UK government criteria in furtherance of its Climate Change Strategy objectives. Its latest greenhouse gas emissions reports are available at www.woking.gov.uk/environment/climate/greeninitiatives. During Sustainable NOW, Woking became the first Borough in England to build a housing development for commercial sale that achieved Level 5 of the Code for Sustainable Homes ratings standard.

6. Conclusions.

6.1 Sustainable NOW has provided 9 city partners with support and mentoring to consolidate and improve their position with regard to local sustainable energy. There was an important emphasis on ensuring that the impact of energy projects was measurable and backed up by sound monitoring regimes. The project set out to support the city partners and to deliver outcomes that would be transferrable and applicable to other, non-participating cities.

6.2 This report shows that although each city partner had a different starting point and level of expertise, Sustainable NOW has helped to bring a level of consistency to the management and reporting of local energy outcomes. Through examining the projects of German and Italian partners, it is apparent that although the approaches may be different, there are a range of local energy solutions that municipalities can deploy, all of which can result in measurable energy and emissions reductions.

6.3 Any city that is considering local sustainable energy solutions would be likely to benefit from contacting the Sustainable NOW city partners. Across the project, there are examples of almost all mainstream sustainable energy options that have been installed, managed and measured successfully, for the benefit of citizens.

7. Further Reading.

7.1 **Details of the 9 city partners:** www.sustainable-now.eu/index.php?id=6842

7.2 **Sustainable NOW downloads**: www.sustainable-now.eu/index.php?id=7346

7.3 **Links to other relevant projects:** www.sustainable-now.eu/index.php?id=6839

7.4 **Sustainable NOW home:** http://www.sustainable-now.eu/index.php?id=6844

7.5 **ICLEI Europe:** www.iclei-europe.org/

7.6 **Intelligent Energy Europe:** http://ec.europa.eu/energy/intelligent/