From A Climate Action Plan (CAP) to a Microgrid:
The SEEU Sustainability Concept Including Social Aspects

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Abstract

Following new global trends, the South East European University (SEEU), besides excellence in teaching and research, is committed to contributing to climate change effects and energy efficiency. SEEU will introduce a microgrid as a further step from the CAP towards energy sustainability. This paper presents the SEEU CAP and microgrid and also highlights benefits that are related to socio-economic conditions and the environment, including social aspects and sustainability.

Keywords: Microgrid, Intelligent Microgrid, Climate Action Plan (CAP), Energy Efficiency, Power Quality (PQ), Green House Gases (GHG), Carbon Footprint

Introduction

The efforts to move towards sustainability in universities, and in turn in society, begin with education. Though educational initiatives have begun to inform campus communities, most people remain unaware of their individual impact on the environment and have little knowledge of environmental issues in general. This lack of knowledge is a symptom of how society has forgotten its relationship with the planet, and only a vast change in how humans view and subsequently interact with the natural environment will bring about a sustaining relationship between humanity and the earth. But, at SEEU and other universities, education extends beyond the classroom. Outreach to the campus and the surrounding community is an integral part of student education at SEEU. Sustainability can be incorporated into these efforts, as well. As a final goal to achieve total energy independence, SEEU, with its intention to follow the latest trend, is determined to implement the Microgrid concept. Microgrids are an integrated energy system consisting of interconnected loads and distributed energy resources that can operate seamlessly with the grid or in an intentional islanded mode. The Campus has started the path to sustainability few years ago with the aim to manage carbon and energy more efficiently. The realization of a Climate Action Plan (CAP) constitutes a roadmap to get Universities to the goals of climate protection, defining a carbon footprint, identifying priority actions, milestones to measure progress and target dates, and raising funding opportunities.

The methodological approach for the realization of a Low Emission Campus through the implementation of the CAP at SEEU foresees the analysis of the current energy consumption, greenhouse gases (GHG) emissions and the integrated planning for the implementation of carbon-friendly measures. Following the realization of the Greenhouse Gas Inventory, the CAP represents a powerful tool to reduce Universities carbon footprint, aimed at delineating strategies and a timeline for reducing greenhouse gas emissions. Furthermore, it allows pursuing the goals of integrating sustainability and climate action in all aspects of teaching, research, and community outreach. Universities can provide both practical and moral leadership to society's efforts to address climate change by showing real steps in reducing their own emissions. In addition, following the EU commitment to provide secure, competitive and sustainable energy as a driving force for the development of a low carbon economy, SEEU is determined to became a pioneer concerning practical implementation over intelligent Microgrid solution in the region. According to this concept, achievement of Perfect Power as total energy sustainability in SEEU will become a reality withinno more than 15 years.

1. SEEU CAP [1]

The SEEU has committed itself to reduce its greenhouse gas emissions and serve as the University country leader in the campaign to fight the climate change. Although Macedonia has no binding reduction commitments deriving from the international climate change regime (in particular from the Kyoto Protocol), the voluntary engagement of SEEU in a greener direction demonstrates an open mind and careful approach to the global environmental problems. The scope of the SEEU CAP is not only to measure and reduce its GHG emissions, but also to develop and implement measures to achieve climate neutrality by eliminating or offsetting those emissions. In fact, universities as a society's source for ideas, have a crucial role to play in climate mitigation: they can generate new knowledge, solutions and technologies, and at the same time reduce their own, often large, carbon footprint. The CAP identifies the emission reductions of each project and sets an implementation schedule over the short, middle and long term that will ensure that the Campus can make a steady progress towards its climate goals. This Climate Action Plan follows the experiences of the first wave of schools all over the world (i.e.: Buffalo, Santa Barbara, Maryland, Montana and other U.S. campuses under Association for the Advancement of Sustainability in Higher Education), which implemented carbon-cutting initiatives showing that a good planning is the best way to ensure good results (Eagan, Calhoun, Schott, Dayananda, 2008).

1.1. Greenhouse Gas Emissions Inventory

The first necessary step for tailoring the sustainable interventions for the reduction of energy consumption and GHG emissions is the realization of a GHG inventory. An inventory quantifies where and how many emissions are generated within the spatial boundaries of the campus. SEEU issued its GHG inventory on July 2010 (D'Appolonia/SEEU, 2010), reporting emissions for the fiscal years 2005-2009 and with a specific reference to the fiscal year of 2009. The inventory is based on the CA-CP Campus Carbon Calculator (CA-CP, 2008). The CA-CP methodology follows guidelines outlined in the World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD) GHG Protocol Initiative. The CA-CP Campus Carbon Calculator is based on international recognized emission factors databases to convert the emission sources into carbon dioxide equivalent emissions. The calculator enabled easy entry and conversion of collected data to its carbon dioxide equivalent based on global warming potential. The CA-CP Campus Carbon Calculator inventoried all six greenhouse gases outlined by the Kyoto treaty. It adapted protocols established by the Intergovernmental Panel on Climate Change (IPCC) for national-level GHG accounting for use at an academic institution (IPCC, 2006a).

1.2. Calculation Of GHG Emissions By Source

The CA-CP Calculator v.6, developed by Clean Air – Cool Planet specifically for universities, was used to create the GHG inventory for SEEU. The CA-CP Campus Carbon Calculator is divided into broad data collection categories. On campus stationary sources of GHG emissions include only the centralized heating system fuelled with heating oil (Mazut). It meets all the SEEU's heating demand, about half of its electricity demand, and provides some chilled water for air conditioning. There is no electricity generation on campus (except two back-up diesel generators for emergency); GHG emissions occur due to the generation of the electricity purchased from the national electricity provider. Since electricity is the main source of energy along the campus (lighting, air conditioning, dormitories equipment, etc.), it results to be one of the main sources of GHG emission at SEEU. The CA-CP Carbon Calculator also categorizes the vehicle fleet by fuel type (i.e.: gasoline fleet, diesel fleet, natural gas fleet). Annual fuel use was provided by the Administration Offices that operated the fleet and/or controlled the fuel-servicing supply. Students, faculty and staff commuting quantifying the GHG emissions from commuter traffic proved to be one of the most challenging tasks. The goal of the commuter traffic component of the calculator is to estimate GHG emissions associated with annual kilometrage traveled to and from campus by University students, faculty, and staff. Air kilometrage data were provided by the administration offices about covered business and study trips. Data on refrigeration and other chemicals were not readily accessible since SEEU is not keeping track of them.

1.3. Inventory Results

The diagram in Figure 1 illustrates the GHG emissions profile over the inventoried years. The overall GHG emissions, after an increasing trend in FY 2005-2008, registered a decrease in FY 2009, while for FY 2010 a new increase to the 2008's value is predicted.

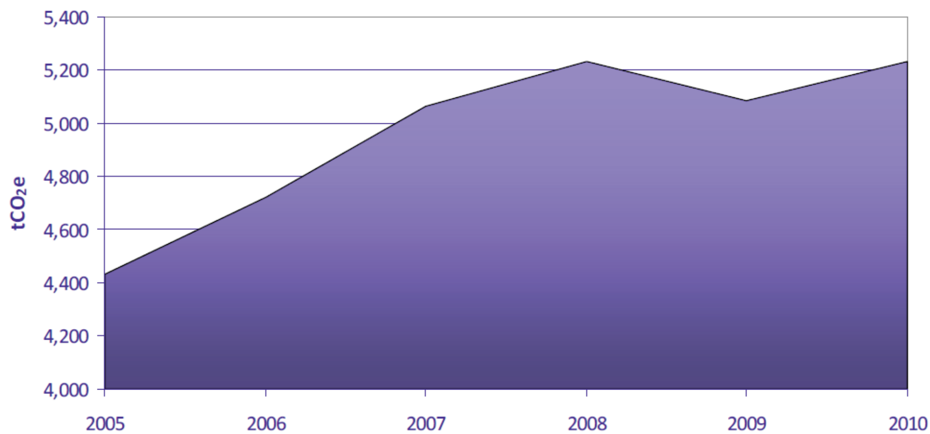

Figure 1. – Total campus Emissions

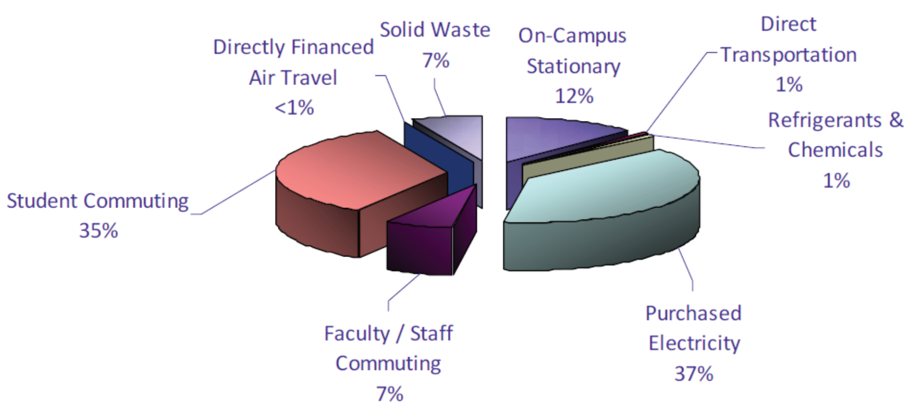

Figure 2. – GHG Emissions by sectors FY 2009

The chart in Figure 2 presents the contribution of each sector in percentage on the total emissions for FY 2009: the main contribution comes from commuting (42%), followed by electricity consumption (37%); on-campus stationary combustion accounts for 12% and solid waste for 7%; the other contributions (direct transportation, refrigerants and air travels) are negligible (around 1% each).

1.4. GHG Reduction Strategies And CAP Goals

SEEU has detected strengths in GHG emission reduction sectors of energy conservation and efficiency, green building design, alternative transportation and solid waste management. Building upon these strengths, as well as formalizing others, will position SEEU to make significant reductions in its GHG emissions over time.

The University management has set an interim reduction target by 2020 to reduce the current GHG emissions at 30%. According to the strategies outlined in SEEU CAP and to the related calculations, the Campus emissions can be decreased at 32%. In 2009, transportation emissions, including those from the University fleet, student, faculty, and staff commuting, and air travel accounted for 43% of all SEEU emissions. Commuting is the major source of greenhouse gases emissions and yet this is not directly depending on the University itself. Thus, the applicability of proper mitigation strategies is difficult. In 2009, on-campus stationary combustion in the centralized heating system accounted for 12% of campus greenhouse gas emissions. The system is currently fuelled with approximately 200,000 liters per year of heat oil (Mazut), a highly pollutant fuel oil. Considering the same final energy demand, three options have been compared with heat oil: methane, LPG and biomass (wood chips). Biomass constitutes an opportunity due to the high potential of the region, which is rich in forests and wood residues. Wood chips can be considered among the alternative fuels in the fuel switch scenario. A strong and well-managed local wood chain is required in the process; otherwise the wood procurement from far and scattered suppliers would make the system ineffective.

Following the analysis on the structures in the energy audits, it was verified that in the prefabricated structures, the perimeter walls and the roofs have very good insulation capacities, whereas the foundations are characterized by a high transmittance capacity. The insulation of building foundations can lead to 20% savings on the winter thermal demand.

The existing lighting system for alleys and interiors is constituted by fluorescent lamps and a mixture of non-energy efficient ones. The proposed retrofit project would replace the energy inefficient lighting with compact fluorescent lamp (CFL) or light-emitting diode (LED) efficient lamps on the external posts for space illumination and with energy saving lamps in the internal spaces.

Domestic hot water is currently produced by means of electric boilers. Electricity is responsible for 37% of the global campus emissions and considerable use of electric devices is responsible for the majority of the operations. Solar thermal is applicable to dormitories for domestic hot water production. The installation of solar thermal collectors could help covering the domestic hot water needs of the buildings, thus resulting in either replacing the electric boilers, or reducing their load.

One of the main goals of SEEU is the reduction of dependence from external energy purchase. Covering all the electric demand of the Campus with photovoltaic (PV) is a challenging objective, therefore a significant investment will be required. However, a considerable share of the demand can be covered through the installation of summing up all the contributions for photovoltaic; the final goal for installation can be 500 - 510kWp.

By applying the grid emission factor to the overall expected electricity production, the achievable emission reduction will be 545 tCO2e/y, corresponding to more than 10% of the total emissions.

Geothermal heat pump has been designed for the pilot building as a single solution. An aquifer is available at few meters below the Campus surface, thus allowing a possible exploitation of such energy source. Theoretically, geothermal could be designed for the whole Campus, but the actual applicability shall be carefully evaluated after the realization of a specific hydrogeological investigation on the area, because the amount of water required by such a large scale system could have an impact on the subsoil system.

Although the campus fleet gives a very small contribution to GHG emissions compared to other campus sources, some fleet-related emissions reduction mechanisms can be thought. Air travel emissions account for a very low percentage on the total emissions, only 1 %, but this is likely to increase as the University becomes a more prominent regional institution. SEEU will work to establish a flexible work program and better incorporate telecommuting and web conferencing capabilities into the University infrastructure to reduce travel, save energy, and avoid emissions. A brand new Campus shuttle system can be implemented. The service will be destined to local and intermunicipal connections, with properly defined timetables. The shuttles capacity and the rides' frequency should be evaluated based on the initial forecasts, and it should periodically be refined on the basis of the success of the initiative.

The Campus also is implementing a pilot project (since 2009) for the selective collection of paper in the Rectorate building. Several bins are placed inside the building to introduce the process of paper recycling. It is suggested to extend this process to the whole Campus along with plastic collection.

1.5. Summary Of Emission Reduction Potential

The following table and chart show a resume of the potential of emission reduction through the implementation of the outlined strategies as defined in this Climate Action Plan.

Several indicators are presented (Figure 3) ,specifically: marginal cost of reduction (in €/tCO2e); the net present value of the project per unit of GHG reduced (tCO2e) The € term is a net present value (NPV) calculation, and includes the upfront costs and the discounted stream of future savings associated with the mechanism. Other indicators include cumulative savings share, Net Present Value and payback period.

Technology	Sector	Scope	Marginal Cost of Reduction (€/tCO$_2$e)	Annual Savings (€/y)	Total Savings (€)	Total Capital Cost (€)	Emission Reduction (tCO$_2$e/y)	Net Emissions Share (%)	Cumulative (%)	NPV (€)	Payback (years)
Foundations Insulation	Energy Efficiency	1	-359	28,000	700,000	1,450,000	125.2	2.5%	2.5%	-1,123,700	52
Solar Thermal	Renewable Energy	2	-179	4,953	123,829	379,506	71.7	1.4%	3.9%	-321,785	77
Selective Collection	Waste Management	3	-115	-	-	8,000	2.8	0.1%	3.9%	-8,000	-
Lamps Replacement	Energy Efficiency	2	5	15,238	380,938	150,370	220.7	4.3%	8.3%	27,201	10
Behavior Modification	Energy Efficiency	2	32	1,346	33,660	-	19.5	0.4%	8.7%	15,690	-
Photovoltaic	Renewable Energy	2	53	254,666	6,366,650	2,250,000	545.9	10.7%	19.4%	717,771	9
Fuel Switch	Energy Efficiency	1	90	47,534	1,188,351	170,000	170.7	3.4%	22.7%	383,942	4
SEEU Shuttles	Transportation	3	156	38,121	953,034	150,000	75.5	1.5%	24.2%	294,251	4
Video-conference	Transportation	1,3	189	14,799	369,975	15,000	33.3	0.7%	24.9%	157,461	1
Carpool/Public Transport Policy	Transportation	3	191	252,787	6,319,687	500,000	359.7	7.1%	32.0%	2,445,880	2
Carbon Offset	Multi-task	1,2,3				2,542	508.5	10.0%			

Figure 3. - Overall Potential of Outlined Strategies - Indicators

The bubble chart, (Figure 4), displays the estimated potential of emission reduction calculated according to the described approach. The bubble size indicates the amount of emission reduction in tons of CO2e; x-axis is related to the total investment cost, whereas y-axis indicates the marginal cost of reduction in €/tCO2e.

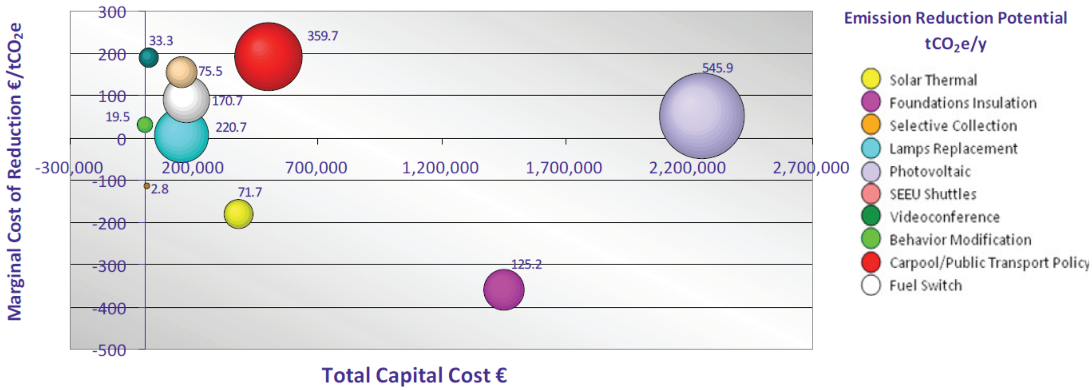

Figure 4. – Bubble chart of estimated Emission Reduction Potential

2. Seeu Intelligent Microgrid

2.1. What Is Microgrid ?

Traditional energetic systems – Macrogrid – determines a centralized system of concentrated energy sources, transmission and usage. Energy transmission is based on the High voltage AC concept which exists since 1880 " War of currents". Due to the distance between sources and consumers, losses in the energy during the transport can be significant. Third millennium consumer requests, as well as technological advantages of the energy equipment, imply the need of specific solutions. One of them represents the basic idea that will be implemented in SEEU.

A Microgrid is a small-scale power supply network that is designed to provide power for a small community. It enables local power generation for local loads. Microgrid comprises of various small power generating sources that makes it highly flexible and efficient. It is connected to both the local generating units and the utility grid, thus preventing power outages. Excess power can be sold to the utility grid. Size of the Microgrid may range from housing estate to municipal regions. Practical size of Microgrids is limited to few MVAs. For larger loads, it is desirable to interconnect many Microgrids to form a larger Microgrid network called Power Parks. The advantages of this Microgrid structure ensure greater stability and controllability for the Power Parks. Microgrid's define the unity of distributed energy resources (DER), accumulation devices and end users (consumers) that are monitored and controlled by the common system and connected with national grid over Point of Common Coupling (PCC). This definition covers a large application space that ranges from remote rural electrification and residential/community power networks to commercial, industrial, municipal, hospital, campus, and military base power grids. The Sample of Macrogrid and Microgrid as a low voltage (LV) Grid is presented in Figure 5.

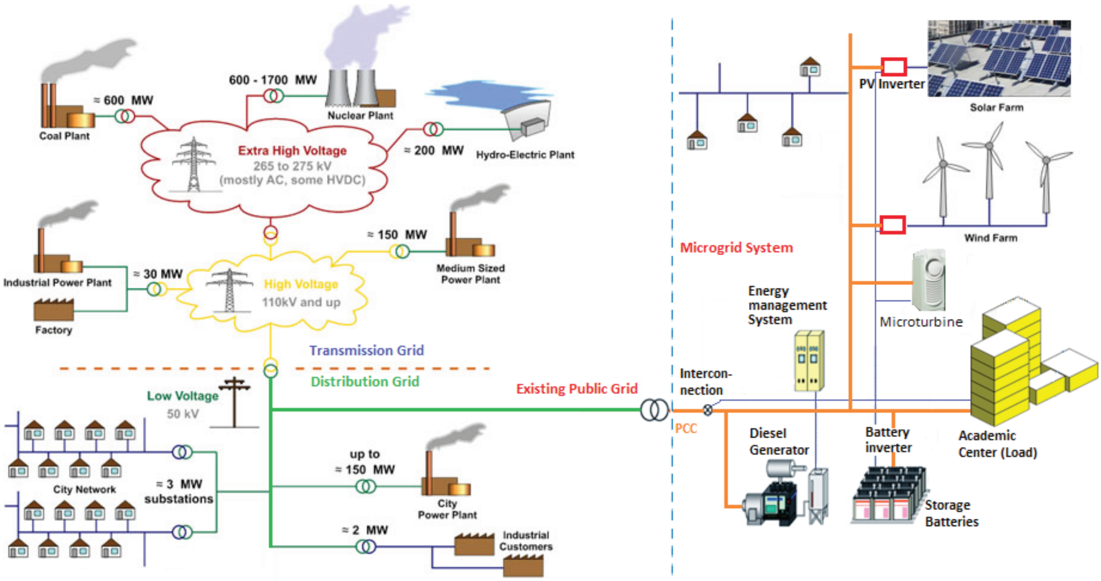

Figure 5. - Sample of Macrogrid and Microgrid as a LV Grid

A Microgrid represents a system that can solve common problems in the area of energy usage by focusing on end user satisfaction. A Macrogrid implements state of the art technologies and innovative solutions with intention to ensure the most secure, highly effective and independent intelligent energy system with possibility for flexible scheduling of consumption and production.

An essential part of this system is alternative energy sources and an intelligent management system. Microgrid as an integrated system of consumers and energy resources can function in two modes:

- Connected with national grid (supported by external energy sources), or
- Island mode (completely based on own energy sources)

As a further development, a microgrid evolves in an intelligent microgrid system. Specially developed tools will be incorporated in the Microgrid infrastructure based on IT technology, intelligent measurement, virtual instrumentation and control and regulation with intention to create SCADA system.

The concept presented in Figure 6 is based on intelligent monitoring and control on electrical and non-electrical parameters. Data acquisitions process is based in a simultaneous mode, where current and voltage are taken into consideration. After applying mathematical algorithm models, values of active power, reactive power, apparent power, power factor and frequency are calculated and compared according to the Power Quality Standard EN50160.

Implemented concepts of an intelligent microgrid: monitoring, controlling, and managing, based on grid and IT resources, makes possible high power quality standards. Accordingly, a number of PQ standard problems, such as: continuity of service, energy outflows during demand peaks, variation in voltage (overvoltage, flicker and dips), magnitude, harmonic content in the waveforms, total harmonic distortion (THD), variations in the frequency can be easily solved.

Other non-electrical values (temperatures, flow, pressure) are also taken into consideration in the process of monitoring and regulation with intention to satisfy a set-up level according to the request of end users

Both the SEEU intelligent microgrid principal design and the SEEU intelligent microgrid architecture evolved from the CAP are given in Figure 6 and Figure 7.

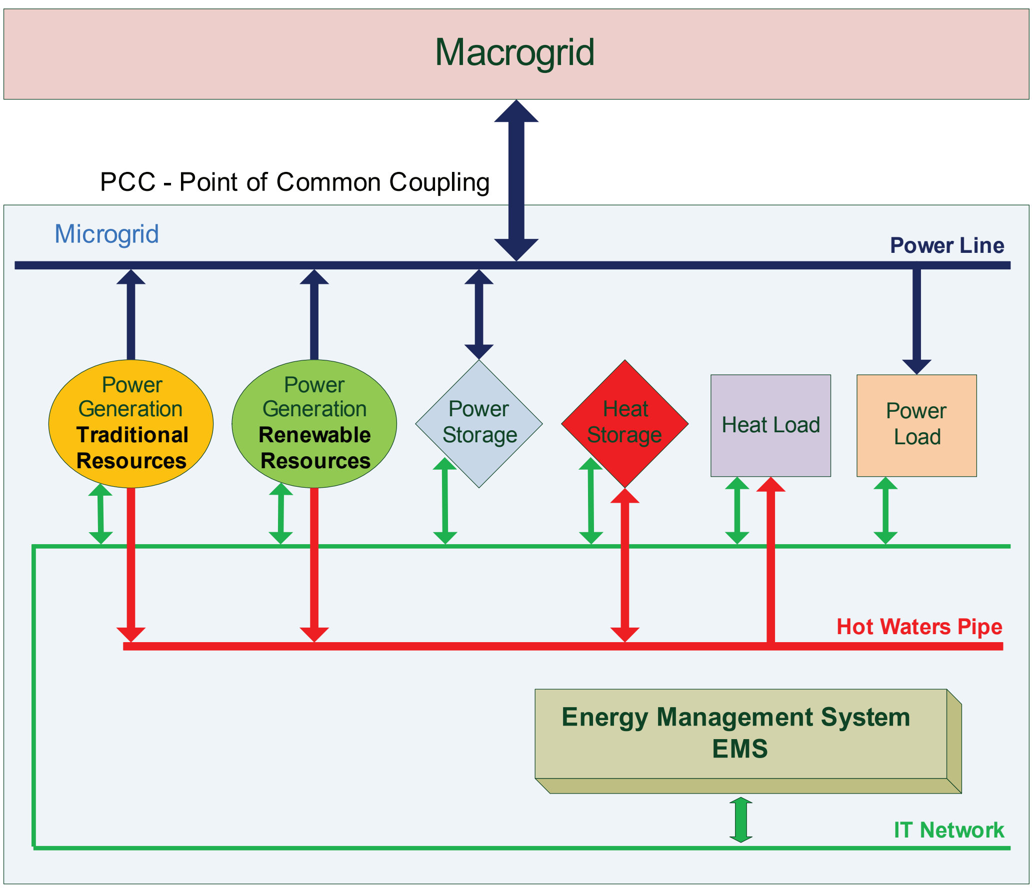

Figure 6. – SEEU Intelligent microgrid principal design (Hot/Cold Waters Pipe)

2.2 Goals

The main goals of the system are:

To set-up a unique microgrid system for renewable energy monitoring, generation and storage

To use the facility for testing system integration of new renewable energy components

To enable web access to the system for a remote access lab in renewable energy

The following types of technologies applied in the Microgrid structure belong to the so called Distributed Energy Resources – DER.

Traditional energy resources :

- Fuel cells,
- Micro combined heat and power (MicroCHP),
- Microturbines,
- Reciprocating engines

Renewable energy resorces:

- Photovoltaic Systems
- SolarThermal,
- Geothermal,
- Biomass,
- Small Wind power system

Energy Storage - ES:

- Electrical Energy Storage
- Batteries,
- Supercapacitor,
- Superconducting magnetic energy storage (SMES)

Thermal energy storage (TES)

Mechanical - flywheels

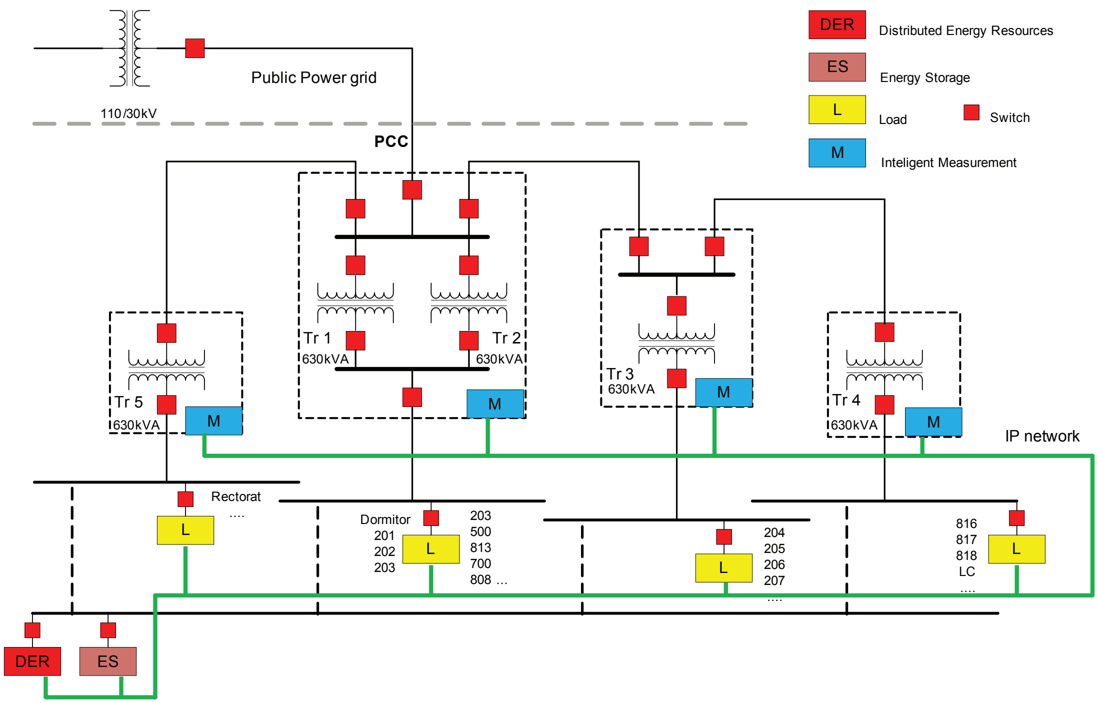

Figure 7.- Proposed SEEU Intelligent Microgrid architecture

Content and capacities:

- Intelligent management system focused on production and consumption of energy
- Central based and distributed base activities
- Two way communications and embedded intelligence - every device can talk and listen, include intelligent meters.
- Fast network response
- Communication net layer as an infrastructure is above IT network; According to the circumstances, it can be aggregated into the power grid.
- Different types of sources are integrated into the system
- Local generators, micro turbines, fuel cells, renewable sources (biomass, wind, geothermal, solar thermal, photovoltaic)
- As part of the system, there are integrated energy accumulation devices with different time response (few minutes up to few hours)
- Self-healing greed, more throughput, more customer choice

- Defined consumption ,current power demand is 600kW and current power peak production capacity is 2MW with possibility that exceeded energy to be delivered to the national grid
- Intelligent measurements and Virtual instrumentation
- Optimization between energy production and consumption based on consumer eds and production
- Security, fault tolerance and recovery
- Energy management system - EMS

The intelligent Macrogrid should have possible future upgrading of the system based on additional consumers as well as new sources and technological achievements.

Challenges which has to be fullfilled based on SEEU CAP and proposed Intelligent Microgrid architecture:

- Intelligent monitoring until 2013
- 30% reduction of energy consumption until 2015
- 50% energy production by renewable resources , until 2015
- 50% reduction of energy production from fossil fuels until 2015
- 200% energy production by renewable resources , until 2025
- 32% greenhouse gas reduction until 2020

2.3. Benefits

Intelligent microgrid is key to building better energy grids. As a result, the following benefits are expected:

Enhanced Capability

Surety – Grid Connected or Independent Operation of Critical Loads
Reliability – Stabilizes unreliable utility grid power
Flexibility – Reconfigurable as energy assets or actions change

Improved Compliance

Efficiency – Savings energy, reduced energy usage through optimal on-site source and load management, and maximum use of indigenous sources of energy
Sustainability – Intelligent integration and control of renewable distributed energy resources and energy accumulations

Increased Cost Effectiveness

Quality – Mitigation of power quality penalties/fees
Ancillary Services – Revenue generation such as renewable energy credits, dispatchable source and load, and peak shaving programs

Security

An intelligent microgrid will help to balance power generation to the demand, which will reduce the potential for blackouts. It will also be able to integrate current energy sources, such as hydro or natural gas, with alternative energy sources, such as biomass, solar, and wind plants.

Protection of environment

Economic benefits

Quality of life

In general, the project will contribute to research and development of contemporary energy sector technologies that will tell us when the cheapest or cleanest power is available. This will allow us to change our household energy consumption patterns to reduce our costs, our carbon footprint, and match our demand cycle to coincide with a smarter power grid infrastructure.

Standards

Since 2008, there is a guide (IEEE Std 1547.2-2008), mainly focused on equipment manufacturing companies, engineers, project managers and electrical energy technicians that are connected with microgrid technologies and distributed energy production. In addition, there is space and need for a more precise definition of standards in this field.

3. Social Aspect

Mission

SEEU's mission is to share knowledge with students and place it in service of the community and society. Therefore, in line with both the institutional mission and the climate neutrality goal, this plan identifies actions to promote research on energy, environment, and climate and to further integrate sustainability in teaching and learning. This will not directly lead to reductions in GHG emissions, but the promotion of cultural and behavioral changes will help in achieving the climate neutrality goal. To a wider extent, SEEU aims to become an excellent example of a Green Campus for the region, a living example of sustainability, where new ideas and strategies to mitigate climate change could be developed, tested, and implemented. Ideally, the University itself can become a learning laboratory for the promotion of sustainability. It will be essential to underline that research and education should become closely related to each other and placed in the larger regional and social context within which the University operates. SEEU goals in the field of sustainability can be summarized in the following areas: establish Sustainability and Climate Change as recognized, emphasized, and common themes across the University curriculum; make Sustainability and Climate Change a center of academic excellence for the University; engage in strategic hiring in other departments and programs to strengthen Sustainability and Climate Change; supplement formal education on Sustainability and Climate Change with informal, practical, and career-oriented education; make Sustainability and Climate Change a prominent feature of events and programs that attract off-campus participants (public lectures, extracurricular activities, alumni events, etc.); strengthen relationships with external organizations for internships and work-based learning; and, develop new funding streams to support the initiatives outlined in this CAP. When discussing energy-related issues, especially, when introducing new concepts, it is very important to provide a broader overview of benefits that are not only technical and specific to the power system, but also related to socio-economic conditions and the living and working environment. The social component helps in understanding the cost-benefit relationship that would motivate customers to follow the new rules such as postponing electricity consumption towards off-peak periods, which in the bottom line, affects their overall living habits.

Role of Education and Research

With the ability to reach thousands of students, faculty, staff, and alumni, SEEU has the opportunity to influence and educate a sizeable population about sustainability. SEEU can accomplish this goal by serving as an example via its construction and operating practices, as well as through outreach programs in Macedonia. One of the most direct and important ways to influence and educate the stakeholders is to address sustainability within the curricula taught on campus. By expanding the numbers of courses available that teach students about sustainability, as well as blending sustainability into core courses and research, these lessons can begin to permeate and enhance student academic experiences. The University target is to become a leader in the field of sustainability and the strategies included in this plan will help further reduce the Campus' environmental impact. The University's commitment towards sustainability must be matched with its efforts to make its curriculum sustainable. Attention must be given to creating a learning environment that produces ecologically literate and socially responsible graduates, able to translate the lessons learnt at the University into concrete actions.

Behavior Modification and Occupation Awareness

One of the most cost-effective ways to save energy and reduce GHG emissions is through changing energy-consuming habits and behaviors. Little attention is usually devoted to raising the consciousness of energy end- users on campus. Since students, staff and faculty do not directly pay the utility bills, the campus building occupants have little incentive to conserve energy; evidence suggests that a significant opportunity exists to reduce energy load through modifying occupant behavior. Education and social marketing can result in energy conscious actions such as turning off unneeded lights, adjusting building temperatures, shutting off equipment, using less hot water, and closing windows and doors. To optimize this strategy, staff should be involved to accomplish the necessary tasks. Students, along with faculty and staff, shall be involved in the process, working on behavior changing campaigns and initiatives along with monitoring success rates. Research shows that energy savings from behavior modification varies widely (Markowitz & Doppelt, 2009), ranging from a 5% reduction to as much as 56%, although this higher percentage was for only a two week period. A more reasonable range is 5-30%. Due to the fact that the campus dependence on electricity is related to a huge variety of fields and not only limited to offices' occupation, the range considered in technical literature about U.S. standards appears overtated. The energy saving potential is related to electricity consumption which is dependent on lighting, air conditioning and electrical appliances utilization. The only cost associated with this strategy is for staff to implement social marketing campaigns and to track progress. One of the most significant barriers to this strategy is the present inability to measure results accurately. In order to do this, a metering system or some other methods of measuring energy savings would be needed. Lack of evidence that behavior modifications are working could represent a barrier to gain broad and long-term commitment to the strategy. During the summer session and over breaks few people are in the Campus. Therefore, it may be possible to combine areas of use and to close some buildings. Energy savings would then be realized from lower heating and cooling needs, less lighting and equipment use. Further study is needed to define exactly which rooms could be closed. Events and staff schedules need to be considered. Two mechanisms are suggested to help raise awareness of campus building occupants: publicize department energy usage and reward departments for energy conservation. Both mechanisms would require the installation of additional building level meters for electricity. Publicly available data on energy consumption would encourage individuals to be aware of their energy consumption. Rewarding departments for energy conservation may help encourage additional efforts to reduce energy usage at individual level. Giving departments a prize, or other financial reward for reducing energy load below some baseline or relative to other departments may help to motivate departments and individuals to reduce more actively their energy usage. According to the energy saving calculation on the current consumption, the reduction of 1% on the total electricity demand for the campus would result in saving 20,400 kWh/y of electricity. SEEU purchases electricity from the national grid, therefore the emission reduction originating from such intervention depends on the electricity emission factor of the grid. Having in mind that the CEF has been calculated with 0.956 tCO2e/MWh, the emission reduction for this intervention amounts to 19.5 tCO2e/y.

Also, the presence of microgrid within the campus, followed by public campaign among the student body, can provoke interest on the existing technology and advancements in the field. In the study process, SEEU habitants, will became aware about differences between inside campus environment and outer reality. Awareness development is a natural process resulting in exposing the environmental influences, illustrating a need for a new vision for the future. Social aspect of energy-related issues are correlated with economical and environmental issues, as they are tightly interlinked and it is difficult to make a real distinction between them. Accordingly, this is a multi-disciplinary and interdisciplinary field.

Conclusions

The Intelligent Microgrid Project reflects provincial, national, and international goals to build a smarter and more secure power grid. The SEEU intelligent Microgrid solution as a vision, will solve the issues concerning energy supply, energy independence, sustainability with an enormous economic and social impact and PQ. Savings, determined as daily occupation and awareness for environmental protection will reflect in regular working and habitable environment. The final solution on the SEEU Intelligent Microgrid will be a real laboratory for hands-on education and training of students in the campus in the fields of energy efficiency, use of renewable energy resources, and IT implementation for monitoring and control. In recent years, the changes in economic and environmental conditions, have somewhat altered the attitudes towards more efficient energy usage, but they have not led to greater changes into daily habits and lifestyles. Therefore, they should be exposed to information on the expected overall benefits of the new concepts in order to accept them as new values.

References

1. South East European University Climate Action Plan (CAP), March 2011
   SEEU working group: Alajdin Abazi, Murtezan Ismaili ,Iljas Iljazi, Darko Spirovski
   DAPPOLONIA working group: Marco Cremonini, Gianluca Cassulo, Alessandro Venturin
2. UK San Diego, Climate Action Plan
   http://acupcc.aashe.org/site_media/uploads/cap/5-cap.pdf
3. Cornell University, Climate Action Plan Summary Report,
   visit on: www.sustinablecampus.cornell.edu/climate/
4. More Microgrids, STREP project funded by the EC under 6FP, SES6-019864, December 2009

5. 7 Mediterranean Conference on exhibition on Power Generation, Transmission, Distribution and Energy conservation
7-10 November 2010 , agia Napa , Cyprus (Paper No. MED10/244)
"Social aspects of wider Microgrids deployment"
6. Electrical Power Systems Quality 2nd ed, Roger Dugan, Mark McGranaghan, Surya Santoso, Wayne Beaty, 2004 McGrawHill
7. Signal Processing of Power Quality Disturbances. By Math H. J. Bollen and Irene Yu-Hua Gu
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