2014
Master’s Graduates

THE MASTER’S THESIS
<table>
<thead>
<tr>
<th>Thesis Abstracts – MASTER'S CLASS of 2014</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technische Universität Berlin Campus El Gouna</td>
<td>3</td>
</tr>
<tr>
<td>Master of Energy Engineering, Abstracts</td>
<td>4-16</td>
</tr>
<tr>
<td>1. Mohamed Magdeldin Abdelwahed</td>
<td></td>
</tr>
<tr>
<td>2. Ahmad Imadeldin Sulayman Ahmad Hafez</td>
<td></td>
</tr>
<tr>
<td>3. Ahmed Aly Sayed Aly Elsayed</td>
<td></td>
</tr>
<tr>
<td>4. Hany Abdelaziz Mahmoud Abdelrehim</td>
<td></td>
</tr>
<tr>
<td>5. Louay Hossameldin Abdelraouf Elmoayd Elmorsy</td>
<td></td>
</tr>
<tr>
<td>6. Mohamed Ahmed Bahaeldien Talaat Noaman</td>
<td></td>
</tr>
<tr>
<td>7. Peter Shawky Saad Abdelsayed</td>
<td></td>
</tr>
<tr>
<td>8. Gautham Srinivas Ganesh</td>
<td></td>
</tr>
<tr>
<td>9. Han Chen</td>
<td></td>
</tr>
<tr>
<td>10. Karim Nashaat Mohyeldin Rizk</td>
<td></td>
</tr>
<tr>
<td>11. Mahmoud Alsayed Alsayed Draz</td>
<td></td>
</tr>
<tr>
<td>12. Mohamed Sabry Saad Mohamed Abdalla</td>
<td></td>
</tr>
<tr>
<td>Master of Urban Development, Abstracts</td>
<td>17-24</td>
</tr>
<tr>
<td>13. Anas Alaa Eldin Fathy Khaled</td>
<td></td>
</tr>
<tr>
<td>14. Husseyn Mohamed Sameh Mohamed Hilal</td>
<td></td>
</tr>
<tr>
<td>15. Papon Kumar Dev</td>
<td></td>
</tr>
<tr>
<td>16. Mohamed Ashraf Ahmed Mokhtar Hilal</td>
<td></td>
</tr>
<tr>
<td>17. Norhan Aly Fathy Aly El Dallal</td>
<td></td>
</tr>
<tr>
<td>18. Anas Youssry Abdalhameid Alhowaily</td>
<td></td>
</tr>
<tr>
<td>19. Doha Moustafa Ibrahim Moustafa</td>
<td></td>
</tr>
<tr>
<td>Master of Water Engineering, Abstracts</td>
<td>25-31</td>
</tr>
<tr>
<td>20. Ahmad Hamed Shaker Hassan Hassan Askar</td>
<td></td>
</tr>
<tr>
<td>21. Nonhlanhla Precious Radebe</td>
<td></td>
</tr>
<tr>
<td>22. Michael Nashaat Franssis Beshai</td>
<td></td>
</tr>
<tr>
<td>23. Mohamed Abdelaziz Abdalla Salem</td>
<td></td>
</tr>
<tr>
<td>24. Ehab Shafik Wahba Soliman Elmallah</td>
<td></td>
</tr>
<tr>
<td>25. Islam Khaled Mahmoud Zakzouk</td>
<td></td>
</tr>
</tbody>
</table>
Technische Universität Berlin Campus El Gouna

Technische Universität Berlin (TUB), Germany, established a satellite Campus in El Gouna to act as an academic hub and research center at the Red Sea in Egypt. TUB Campus El Gouna currently conducts three advanced Master’s degree programs in:

- Energy Engineering
- Urban Development
- Water Engineering.

All two-year programs comprise 120 Credit Points (ECTS) and are taught in English. Students graduate with a full Master’s degree by Technische Universität Berlin. Next to their study time in El Gouna, they spend up to one year at TUB’s mother campus in Berlin.

TUB Campus El Gouna was founded as a nonprofit Public-Private-Partnership between TU Berlin, Orascom Development Holding (ODH), and Sawiris Foundation for Social Development (SFSD). Teaching and research are conducted by staff of Technische Universität Berlin and international experts under German regulations for higher education.

The exceptional location of TUB Campus El Gouna provides a state-of-the-art environment for studying and research, while serving as a bridge for scientific and intercultural exchange between Europe, the MENA region, and the other parts of the world.

For more information, please visit:
www.campus-elgouna.tu-berlin.de
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Master of Energy Engineering

Energy has been a key factor in the development of countries, enabling their economic growth and shaping their environments to the needs of human society. Due to the increasing requirements for energy and its carbon based generation, however, a range of serious problems have evolved, such as the exhausting of resources, air pollution and global warming. Air pollution was successfully tackled during the second half of the 20th century and is no longer a serious problem. The problems around resources and CO2 emissions, however, remain. Using renewable energies on a large scale could eliminate these problems. Renewable energy technologies include biofuels, solar heating and cooling, solar power, as well as water and wind power. Research and development at universities and industries faces the challenge of how to find innovative concepts for a safe, sustainable, and economic energy supply in the future.

Main focal points of Energy Engineering are:

- Energy engineering, with particular emphasis on applied and advanced thermodynamic and economic aspects;
- Energy conversion techniques and integration of renewable energies, with practical experiments involving conventional conversion systems.
- Refrigeration and air conditioning under special climatic conditions.
- Energy for buildings, especially primary energy consumption for heating and cooling equipment, along with calculation methods for planning of sophisticated homes and offices.
- Electrical energy engineering, with special consideration of photovoltaic and different kinds of energy storage systems.
- Energy economics and systems, focusing on complex energy systems and the integration of renewable energy in markets, ensuring secure supply and commodity markets.
- Soft skills, intercultural competence and research methods.
- Practical interdisciplinary energy projects and industry internships.
Master’s Thesis Abstract

Supercritical water gasification, SCWG as a mean for hydrothermal processing of biomass, has illustrated the potential to counter technical barriers that continue to face the wide deployment of biomass based energy systems. The advantageous varying chemical and physical properties of water around the pseudo critical point allow for energetic efficient recovery of the organic constituents in solid biomass. This research provides a systematic approach to fill the knowledge gap for upscaling the process from laboratory bench scale to commercial demonstration.

The thermodynamic constraints and drivers of the SCWG reactor were analyzed with an equilibrium model developed on Matlab(R) that depicts the solid biomass transformation to synthetic gases. In addition to, a reactor simulation model on Aspen plus(R) was developed to assess the influence of the different heterogeneous structures of biomass as well as the overall energetic conversion of the process. Based on parametric studies, design decision variables were used to select optimal process conditions as well as an appropriate feedstock to maximize the energetic valorization into synthetic natural gas, SNG and hydrogen.

Conceptual plant flowsheets for SCWG of spirulina algae were developed on Aspen plus(R) for both SNG and hydrogen production. The advantageous reactor system configurations are integrated in the process layout with consequential gas purification, mechanical power extraction and downstream indirect production to maximize the energetic polygeneration of chemical fuels, power and thermal heat. The design and synthesis for the process blocks, components and equipment was based on operational data for referenced pilot or commercial units.

Heat integration studies based on the pinch analysis method were conducted for the conceptual designs. The minimum process utility demands were computed, and different energy recovery scenarios as well as alternative design configurations for optimal heat recovery were assessed. The thermodynamic performance of designs were evaluated by the overall process energetic and fuel equivalent efficiencies.
Master’s Thesis Abstract

The aim of my thesis work was to enhance the radio frequency (RF) magnetron sputtered hydrogen-doped indium oxide films (which are known for their high Hall mobility) by reducing plasma damage in terms of the uniformity of electrical properties. Films deposited using ceramic magnetron sputtering suffer from plasma damage because oxygen is a part of the ceramic target. Such films are still a rather new topic, since work with them just began within the last decade, initiated by Koida [2]. In 2007, Yasui could mitigate this effect for aluminum-doped zinc oxide, using a negatively biased mesh electrode [3].

In this work, I tried to apply the same idea for hydrogen-doped indium oxide films. In a series of experiments conducted at the PVComB, part of the Helmholtz Zentrum Berlin, in year 2014, I was able to mitigate the plasma damage effect under the target center, using a negatively biased mesh electrode.
Master's Thesis Abstract

In developed world, the three main criteria that characterize the energy supply of the future are: sustainability, security, and competitiveness. Hence expanding the share of renewables into the energy mix is highly regarded. Recently, some developing countries realized their potential for generating electricity from renewables, yet still have concerns regarding reliability and economic feasibility of such unconventional technologies.

Throughout this study, the electricity sector of the Arab Republic of Egypt has been analysed, the most promising location of technology-specific renewable energy technologies has been identified, and a capacity expansion master plan (with planning horizon until 2032) has been suggested in order to optimally integrate renewables into Egypt's existing power plant portfolio.

In the core of the followed methodology comes the capacity expansion and unit commitment optimization model REMix-CEM that has been developed by the German Aerospace Center (DLR) in order to support MENA countries in integrating renewables efficiently into their current fossil-fuel dominated power systems. REMix-CEM optimizes the capacity expansion of conventional and renewable technologies through minimizing the total generation cost of the entire system while maintaining continuity of supply.

The study concluded that nuclear option and introducing imported coal to Egypt's fossil fuel portfolio are both economically unfavorable. The capital cost of Concentrated Solar Power (CSP) technology need to be reduced to foster its earlier integration. One of the most remarkable findings is that not integrating further renewable energy technologies will lead to higher average system cost in the future.
Master's Thesis Abstract

Egypt’s Delta and Valley with the highest population and agriculture density is threatened by the depletion of the most abundant available water resource; the Nile River through flood irrigation mainly, and inundation attributed to climate change scenarios worldwide and locally through pumping driven dominantly by subsidized diesel fuel over other power sources. To mitigate the risks, the government reclaimed more than 3 million acres in the desert for agriculture utilizing the second abundant available water resource; underground water for irrigation as well as reforming fuel subsidies to encourage farming stakeholders to exploit the excess solar irradiation levels for powering the irrigation lifting devices.

Nevertheless, with the little unpublished of the viability of PV pumping, farmers are skeptical of the return on such investment despite the unavailability of diesel and ever increasing prices. In the intention of assessing the current situation, a technoeconomic mathematical model was formulated with unit water costs of water as an objective function and a discounted payback period as an auxiliary indicator to gage the feasibility of PV pumping over the diesel in the geographic areas of potential.

The base case at a relatively low hydraulic load of circa 2400m³/day yielded unit costs of water of 0.17 and 0.32 US$/m³ for PV and diesel pumping respectively and a payback period of 4.3 years. This is not the case at higher hydraulic loads, the PV pumping tends to be less feasible with units costs of water close to that of diesel, interpreted into payback periods 12 years and increasing with increase of hydraulic loads. However, this trend was suppressed when varying the influential parameters in the sensitivity analysis.
Master’s Thesis Abstract

Electricity blackouts are recently common in Egypt since the year 2012 as the consumption of natural gas exceeded its production after the year 2011 which created a big deficit in the total electricity production in Egypt, in the same time 70% of the Egyptian power plants under operation are depending mainly on natural gas for electricity production in the year 2012 (U.S. Energy Information Administration, 2014), which means that there is an energy security problem in Egypt which requires diversifying the energy sources. Consequently such problem makes the Egyptian Market very suitable for introducing solar technologies especially as it is one of the countries having highest values of direct normal irradiance.

The main aim of the Master’s thesis is to find out whether integrating concentrated solar power would be a good transition or not, which can be decided by calculating the levelized cost of electricity. So an integrated solar combined cycle having a capacity of 345 MW is designed using the Linear Fresnel technology due to its cheap cost compared to other technologies then a complete exergy, economic and exergoeconomic analysis is applied to the power plant. The solar field provides one third of the heat to the power plant during day operation, resulting with plant exergetic efficiency of 52.2% during day operation which increases to 58.2% during night operation without including part load analysis. $300 million is the total capital investment for the power plant, in addition to $750,000 will be paid yearly for operation and maintenance, moreover $88 million will be the costs paid yearly for fuel based on the consumption of 9.6 kg/s and 11.4 kg/sec during day and night operations respectively resulting eventually in an approximately equal levelized cost of electricity between day and night operations of 47.92 $/MWh and 48.09 $/MWh respectively.
Master’s Thesis Abstract

The rapid increase in Energy demand is urging humanity to search for sustainable alternatives for energy production, all around the globe; it became an undeniable truth where every stakeholder is trying to find out appropriate answers. In this research work this challenge is tackled with a special focus on Egypt through studying, simulating, analyzing, and benchmarking Concentrated Solar Power (CSP) tower plants by focusing on mature and novel high efficient power cycles technically and economically.

A thorough literature review was carried out to investigate the different technology factors involved, understand the main differences and potential of tower technologies and how these technologies are integrated together with the conventional mature power cycle and could be incorporated with the newly proposed power cycles. The comparative analysis which the study is based upon is focused on the achievable efficiencies for each cycle and on design simplicity and compactness that is a prime factor to determine capital costs.

Novel high-efficiency thermodynamic cycles were recently cited to have capability of enhancing the solar tower technology’s efficiency by 13% and to reduce levelized cost of electricity (LCOE) up-to 2 $/kWhe. The aim here is to economically study selected cycles and conduct an exergy analysis for future exergoeconomic optimization for the promising cycle achieved. This promising cycle was chosen to be the Supercritical-CO₂ closed Brayton cycle with recompression, where it was simulated and compared economically against the mature Rankine cycle under different solar tower configurations in order to supply base-load electricity.

A base-load power plant was simulated for the two cycles (mature vs. promising) with a 3 solar-multiple setup in order to achieve a capacity factor up-to 70%, and a plant working 24/7 with a 100% solar share. Molten-salt technology was assumed as a standard for all cases, along with assuming theoretical operating temperatures as high as 900 °C for the case of the S-CO₂ closed Brayton cycle with recompression.

Accordingly, three cases were studied for modular and central tower configurations to investigate economically against the mature steam Rankine cycle.

The exergy analysis demonstrated around 71% exergetic efficiency for the recompression S-CO₂ closed Brayton cycle at 900 °C turbine inlet temperature for a modular 10 MWe solar tower, while the economic analysis showed an LCOE of 0.11 $/kWhe for the steam Rankine cycle in a central tower configuration, 0.105 $/kWhe for the S-CO₂ closed Brayton cycle in a central tower setup as well, and 0.125 $/kWhe for the other S-CO₂ closed Brayton cycle this time for a modular 10 MWe solar tower that is aggregated in a solar park with the same overall capacity. Finally, these results were benchmarked against combined cycle gas turbine technology (the most widespread base-load technology) and future electricity tariffs in Egypt.
Master's Thesis Abstract

Maisotsenko cycle (M cycle) is a new developed thermodynamic process for indirect evaporative cooling. Recently it had been proven as a mature technology, used widely in USA market which is able to save electric energy up to 86% compared with traditional compressor air conditioners. In addition it mainly depends on water and humid air (renewable resources), therefore it is considered as a Green technology. A lot of researches were developed for improving this cycle, but very limited research work investigated the M cycle from the exergetic point of view.

This master thesis work discusses the full exergetic analysis for the cooling units based on M cycle for the Egyptian operation conditions. It also highlights a summary about the previous work done for integrating the M cycle in different cooling towers systems as well cooling units. Where the actual recorded running costs for small cooling units used in offices is about (0.33 ¢ of US dollar / hour) for the water consumed and for the electricity (6 ¢ of US dollar / hour), which is quiet cheap when it competes with comparable AC cooling units that cost about (65 ¢ of US dollar / hour) for electricity.

The study showed the capability of M cycle to be integrated at the different working zones selected, with the aid of desiccant and/or humidifier. As for Cairo city it can cool down the air temperature from 42°C with relative humidity 21%, to a dew point temperature of 16 °C, and for ELGouna weather data it can cool air down from 36°C with relative humidity 29% to about 16°C. The M cycle achieved a maximum total exergetic efficiency of about 16% for the Egyptian operation conditions.

On the basis of the results of this thesis, it can be the theoretical background for future evaluation of M cycle cooling unit using exergoeconomic analysis, which would be a powerful tool for the evaluation of the electric loads caused by cooling systems that burdens the national grid causing power outages during summer time. It can facilitate the inception of M cycle in the Egyptian market.
Master’s Thesis Abstract

With emerging economic development, comes greater demand for power. This demand for power is accompanied with increased capacity of power plants to meet the requirements. In a country like India with exploding population growth, this increased capacity is mostly consumed by big industrial consumers and urban areas alike. Being at the bottom of the pyramid, small towns and rural areas are often overlooked and their demands ignored, however little they may be. Power shortages are quite frequent in such areas. The state of Tamilnadu in the south of India, with a population of about 70 million, is a standing example, wherein the power supply in 2012 was about 7500 MW against a demand of 11,500 MW; with a shortage of an enormous 4000 MW [1].

On the other hand, rural India has great unused potential. Biomass, among other Renewable Energy sources is the most attractive for utilisation in these regions. Traditionally, animal and plant wastes like cow dung and firewood have formed a significant part of people’s everyday energy needs such as cooking, water and space heating. However, with a paradigm shift towards modern fuels such as LPG, these non-commercial sources of energy have lost much significance in certain parts. In regions where they are still in use, they cause health and respiratory problems due to direct firing and prolonged exposure to the toxic fumes.

This thesis aims to develop a micro-mini combined heat and power unit, which shall serve as a decentralized source of power and heat/cold. The plant shall work on locally available biomass (rice husk, cow dung, firewood etc.). This CHP unit shall be coupled with an absorption refrigeration system. The first step would be to identify the demand of power and cold for an Indian village or a small town. The cooling demand would lead us to the detailed design and analysis of the absorption system. Hence, the final steps would include design of the CHP plant, including exergy, economic and exergoeconomic analysis and optimisation.
Master's Thesis Abstract

The liquid solar fuels (LSF) concept helps counteract fossil fuels shortage and give a new solution in the transport sector. The liquid fuel consumption of the transportation sector amounts to about 91.44 million barrels per day in 2014 and this number is likely to further increase in the near future [9]. A share of the fuel used in the transportation sector may be alternatively substituted by the introduction of e-mobility, in particular in the short-distance transportation sector. The synthetic fuels from renewables for longdistance transportation will be important due to the scarcity of liquid fossil fuels in the next decades.

These work is aimed to perform a first pre-feasibility study of the LSF concept: the concentrating solar power plant (CSP) generates the electricity to run the several required system components such as the multiple stage effect (MED), the reverse osmosis (RO), proton exchange membrane electrolyzer (PEMEL), alkaline electrolyzer(AEL) and synthesis process. The key component of the system is the synthesis reactor: here the hydrogen provided by the electrolysis and the CO2 -which may be provided by carbon sequestration units- are mixed to form the liquid solar fuel. After each of the mentioned components have been characterized by a simplified techno-economic model, a first attempt of system analysis of LSF has been performed. 6 main scenarios have been considered, which differ in the used electrolysis and desalination technology. In the MED case, the heat required by the desalination plant is provided by the waste heat (70 C) of the CSP steam turbine. The produced distillate of MED is almost salt-free, which is not the case of RO.

In the technical simulation model, simplified calculations have been carried out. The most relevant mass flows and pressure are calculated. According to the model assumptions, the best option is the PEMEL with a mixture of MED and RO. In this particular case, the calculated system efficiency, i.e. the ratio between the energy content of the fuel and the solar energy required to produce that fuel, amounts to 22.4 %. In the economical simulation, the results show the levelized fuel cost (LFC) is around 2 to 2.3 e/l (in 2025).

An additional advantage of the proposed concept is that a drinking water surplus is generated, which is used for local supply. This allows for avoiding overexploitation of underground water resources and positively contributes to the social and economic local development. It has strong impacts on the local economics and avoids over-exploitation of underground water resource. That is a win-win situation, not only synthetic fuels from renewables but also change the local living and economical conditions.
Master's Thesis Abstract

The presented thesis is concentrating on the Egypt's energy crisis especially in the past 3 years, due to shortage in fuel. Egypt presents one of the perfect locations for solar thermal energy utilization with irradiance ranging between 2000 - 3000 kWh/m² annually. The linear Fresnel focusing technology presents one of the options for such utilization and the newly developed concepts by Novatec Solar which features Direct Molten Salt System (DMS), which provides thermal energy storage and features molten salt as high temperature fluid and working fluid. Linear Fresnel systems with storage present stability and higher capacity factors. The presented thesis is a first step to investigate the feasibility of combining the DMS system with gas turbine to cover base and peak load and reach higher security of supply on one hand and low tariffs on the other hand.

The Direct Molten Salt integrated solar combined cycle (DMS-ISCC) proposed examines the potential of retrofitting Open Cycle Gas turbine cycle with a direct molten salt linear Fresnel based system. The chosen site for the analysis is El-Kharga south west of Cairo and 200 km for the Nile Valley with a gas supply source in Asyut. The Kharga irradiance is 2600 kWh/m² the simulation of the system was based on Macro based Excel sheet and Thermoflex software.

The 300 MW DMS-ISCC proposed plant has a solar configuration of 3.1 Solar Multiple, 12 hours storage, and a 7 series GE Gas turbine. The energy shares reached are 43 % (solar share + Storage) and 57 % Gas turbine share. The economic assessment conducted reached Levelized costs of Electricity in 2020 of 94 €/MWh compared to DMS only system of 109 €/MWh and combined cycle of 70 €/MWh; for a fuel price of 3.8 USD/MMbtu and fuel escalation rate of 4%, with fuel savings potential of 6 mio €/year.

According to the current situation of fossil fuel based power generation technologies, it shows that combined cycle is the most economic choice for countries with good reserves of natural gas. However countries like Egypt moved from natural gas exporter to an importer. Import prices now is in the range of 11-13 USD/MMbtu, with such prices, the Concentrated solar power with storage technologies such as the DMS system can propose an economic solution and with the potential of saving the scarce natural gas.

*Master Thesis in collaboration with Novatec Solar*
Master's Thesis Abstract

This thesis contributes to the "Smart distribution System operation for maximizing the Integration of renewable generation" (Sustainable) project. Sustainable is a European project under the seventh framework programme for research and technological development. It is a collaboration between a number of European universities for the optimization of electricity distribution systems integrating renewable energies.

The thesis investigates the impacts of harmonics on the distribution network components, starting with definitions and foundations related to the harmonics propagation in electrical distribution networks. Finite Element Method (FEM) is used to model the Low Voltage (LV) cables of the CIGRE (International Council on Large Electric Systems) benchmark. Furthermore, LV cable parameters (R, L, and C) are calculated at several harmonic orders. The possible harmonic sources existing in residential LV distribution networks are modelled. As a result of that, Fast Fourier Transform (FFT) of their current waveforms are obtained. In addition, the study calculates the Norton equivalent of non-linear loads. A scenario of future penetration of harmonic sources in residential LV distribution networks is developed. Based on the CIGRE benchmark, the LV distribution network is modelled. Lastly, a harmonic load flow for the CIGRE benchmark is conducted.

The results reveal:

- **Very high accuracy** of using FEM to calculate LV cable parameters, compared to other methods (e.g. Carson's modified equations).
- **The harmonic emissions** due to the household appliances such as TVs and PCs are the main sources of harmonics in LV distribution networks while photovoltaics at lower harmonic orders produce a lesser amount of harmonics.
- **Most of the third harmonic** power is lost in the transformer resistance, what makes calculating transformer parameters at each frequency is crucial.
- **Zero-sequence power loss** at third harmonic order is significant. Hence, different cable sizing or different neutral configuration, than the phase cable should be considered.

At the current situation of harmonic emissions in LV voltage distribution networks, the Total Harmonic Distortion (THD) lies still within the regulation limits and will increase significantly due to the estimated increase of harmonics emissions by 2050. However, according to the analysis, the THD will stay within the harmonic regulation limits.
Master's Thesis Abstract

This thesis’ research aims at developing a decision matrix for optimizing energy efficiency and life cycle costs for new planned residential buildings in Egypt. The decision criteria adopted in this thesis would be of use to developers working in residential sector. It can be of interest as well for other governmental and non-governmental entities concerned with sustainability issues. The research is concerned with analyzing and applying a decision making process that matches the Egyptian case. It focuses on passive energy efficiency measures represented in the building envelope characteristics and performance.

A real existing, pre-validated building model is used. The model under inspection is located in “El-Gouna” city near Hurghada. The simulation program used was IDA-ICE. Simulations were done throughout a full year for every proposed alternative. The climatic data was taken from energy plus files for Hurghada region. The materials data extracted to be simulated and assessed in this thesis are either extracted from construction companies working in “Egypt” or from the “Egyptian” HBRC.

A reference building is defined within this thesis along with user profile. Two assembly cases and three main variants were simulated and further analyzed in this thesis. The common building structure within El-Gouna area is simulated. Another case is investigating the compliance to Egyptian residential building energy code EERBC. The different variants are concerned with insulation thickness, brick thickness (for walls) and window glazing types. Results’ analysis for the performance of different simulated cases, focused on yearly cooling load reduction, peak cooling load and thermal comfort.

The capital costs of all the construction materials used is calculated based on real market values for material and installation costs. The electricity price increase set by the Egyptian government is demonstrated along with its effect on the decision making process. Payback time is then showed and compared for each variant step.

This thesis proposes objective criteria for the rating of different adopted passive energy efficiency measures. The objective criteria proposed here is based on the Egyptian pyramid rating system GPRS. The rating system is modified to the scope of the thesis. The proposed rating system is applied to the simulated results by giving score to each one. Two further economic indicators are assessed -according to the LCC analysis- and added to the decision making process.

The application of the proposed decision making process on the context of El-Gouna area is made. The results showed that the code compliance through perspective method is not the best scenario in terms of both sustainable and financial aspects. The best solution (among the investigated variants) in El-Gouna context is found to be External wall thickness of 12 cm red hollow brick with 8 cm expanded polystyrene insulation. This option is having a payback time of 6 years and a high return on investment.
Master of Urban Development

Urban growth is extensively transforming the face of the planet. For the first time in human history, more than half of the world's population now lives in towns and cities. With an average growth rate of 2.1% per annum from 1990-2003, the MENA region has one of the world's most rapidly expanding populations, increasingly concentrated in urban areas.

Cities in both the MENA region and other parts of the world are engines of growth, providing a disproportionate share of income opportunities and access to services. At the same time, cities are places of growing social and economic inequality, with increasing numbers of people living in poverty and deteriorating living conditions. Furthermore, urbanization also poses a significant challenge in the 21st century, with an estimated 80% of global greenhouse gas emissions linked to urban areas. The enormous contribution of urban areas to global greenhouse gas emissions is set to increase even more.

The Master's program Urban Development focuses on specific aspects of sustainable urban regeneration, participatory planning approaches, and holistic thinking. It lays a strong emphasis on the practical application of the subjects of study while fostering a process-oriented and interdisciplinary approach among students. The program's content includes current trends and methods, as well as extensive semester projects, in which interdisciplinary teams deal with typical problems in a real-world environment.
Master's Thesis Abstract

This thesis intends to contribute to the current debate regarding achieving local communities’ development in Egypt through either centralizing or decentralizing the decision-making process. After the raise of voices, the debate glowed between revolutionists and the country’s representatives on the Egyptian system. The thesis aims to analyze the current planning system and compare it with international theories on the involvement of the citizens in the planning processes.

The thesis starts by reviewing the international theories, in particular, those by Arnstein, Booher, Innes, Margerum and Grey, in order to understand the special relation between authorities and participation of the public. The thesis concludes those theories in six key elements to make this relation efficient and effective enough. They came as the following: Diversity, interaction, cooperation and coordination between local councils, local community and other stakeholders. In addition to, the decisions made by consensus planning, the laws and regulations that support the public integration in the planning process. Then the thesis starts to describe the Egyptian spatial planning decision-making process and the local administrative system showing the difference between them. After that, the thesis reviews the Egyptian literature including documents by associations and Ministry of Local Development that describes the defectiveness of the current local administrative system. Focusing on centralization in Egypt and showing its effect on the urban fabrics and status.

Observing that, most of the literature focuses on building the institutional capacity, the reformation of local councils’ structure and the empowerment of the public participation. Taking into consideration that so far little attention has been given by Egyptian authors about how to integrate citizens in the system. Then the thesis will go to link between reality and theories by studying in more details those features at the grassroots level. The chosen case study is “El Ghaneym” city’s strategic plan preparation, a typical mid-population Egyptian city. As a result, a number of legislative, institutional and individual factors were identified resulting in relatively weak public participation in the urban planning decision-making.

Building on the above, the thesis concluded that Egypt is a country with a very weak administrative system, with low capacity, in both numbers of employees and in terms of their professional qualifications and skills. Moreover, the study shows that the country is trying to reduce the degree of centralization in the urban planning system but still puts the local levels’ managing in the hands of the central ministries. Regarding the urban planning system, the country is now trying to put more responsibilities on to the GOPP represented in its Regional Centers. Adding to, encouraging the people to participate by forcing the mandatory public hearings but still within the existing framework. Finally, the thesis argues, that this is not sufficient, either because of the weak and unclear legislative system or because of the weak individual capacities, making the system inflexible and inefficient.
**Master's Thesis Abstract**

With the prevalence of ageing and overweight worldwide in today's world, studies have shown that at least 10% of the world's population are differently-abled (WHO, 2010). This makes barrier-free planning more important than ever as the aggregate of barriers - physical, social, financial, and behavioural - is preventing more people from active participation and from having equal opportunities in life. Consequently the value of the accessible tourism market is getting more recognition as a business opportunity and not charity. The accessible tourism market is found to be one of the most valuable in the tourism industry as tourists with special accessibility requirements have a higher dispensable budget for traveling, are more loyal to the destination, have a higher companionship ratio, travel more in the low seasons, and depend more on reputation and word of mouth than the average tourist (Buhalis, Eichhorn, Michopoulou, & Miller, 2005; Van Horn, 2002; Phillips, 2002; Office for Disability Issues, 2010).

A country like Egypt with a general poor proposition of accessibility is currently unable to attract and benefit from the accessible tourism market, however there is a high potential demand conditioned with improved accessibility. To achieve this a number of barriers need to be removed starting with the physical infrastructure, as well as a shift in the common mind-set and a culture that is not in favour for the inclusion of the differently-abled. The case study on El Gouna shows that the special nature of El Gouna makes it the perfect place for being the first barrier-free town in Egypt. Privately owned, self-governed, confined and with the political will of El Gouna's top management to realize the project, there is a great chance for the successful implementation of a project making El Gouna the first barrier-free town in Egypt and for making great returns of the accessible tourism market.
Master’s Thesis Abstract

Numerous attempts have been accumulated feverishly in last two decades to improve energy efficiency and to declare green city. Green Pyramid Rating System (GPRS) promoted by Egyptian Green Building Council (EGBC) is also such type endeavor to achieve energy efficiency as well as sustainability. Though most of the indicators of this corridor are developed to promote green building but it is widely possible to apply those indicators in terms of neighborhood. Again, without a whole neighborhood entity, it is challenging to establish something only for building. GPRS is quite promising though it is still like a new born baby as like its mother organization EGBC. This study discusses various dimensions of existing GPRS guideline and fosters some revival strategies to extend its acceptance.

At the initial stage, this study reflects on existing gaps or limitations of GPRS which portrays multiple errors in point calculation, policy inconsistency, lack of operational methodology, missing indicators related to economic efficiency and socio-political arena, absence of case specific example and so on which derive to the next stair of reviving it through articulating branches of international, regional and national certification systems. Finally this study upholds a revised policy guideline blending indicators from ISO, CEN, OECD, ASTM, ANSI, ASHRAE, Green Globe 21, African Green City Index, LEED, BREEAM, DGNB and Pearl; incorporating Statement of Purpose, calculation procedure, submission criteria, further reference and so on to make it more SMART, Visible, Applicable and comprehensive.
Master's Thesis Abstract

WEF NEXUS, a term called on integrating the water, energy and food securities together as an approach for a sustainable, green and efficient way to consume these resources.

Throughout theoretical and practical examinations, it was found out that this approach supports national economies against possible financial risks and improves its conditions within three main dimensions, which eventually fits the MENA region economy’s needs:

1. Encouraging and diversifying productivity through technological innovation.
2. Increasing the net revenues by reducing the consumption costs.
3. Marketing the cities for entrepreneurship investments through providing a sustainable quality urban environment.

In Egypt, there is a definite risk that energy prices will increase within the next five years, in addition to energy supply scarcity. By applying the approach on the suggested case study “El Gouna” on the red sea; new forms of energy productions were established, the net revenues according to the energy prices at the fifth year will increase by more than 160 Million EGP and new possible opportunities for investments and entrepreneurship would be created, mitigating any possible economic crisis that might occur, especially during the current unstable political, economic and security situation.

El Gouna, as considered a developed urban community, fully equipped with proper infrastructure, can act as a small model of big urban communities with complex economic structures. Therefore, what is applied in el Gouna can be highlighted as an example of what can be applied on other mega and small cities in the MENA region.
Master's Thesis Abstract

The MENA region is a challenging, rapid urbanizing region, with a special profile; culturally, socially, economically and environmentally. Despite the diversity between different countries of the MENA region they all share similar urban challenges where extensive interventions are crucial. A climate sensitive region as the MENA region requires special attention for development.

This research is an attempt to prove that the approach of climate as an initiator of the conceptual urban form leads to a more energy efficient urban morphology. The methodology is relating the different passive strategies suitable for the MENA region with the design parameters responsible for the creation of the urban form. Parameterizing the relation between the climate and the urban form in a detailed manner is the basis for creating a parametric platform able to generate conceptual urban forms suitable for each local climate zone. Various conceptual scenarios based on computational models are the results of using the proposed platform on the concrete case of New Aswan City in Egypt.

A final criticism of the approach is conducted showing the feasibility of the resulting model economically. Finally some push and pull policies are to be recommended to help integrate these solutions into the planning process.
Master's Thesis Abstract

Egypt is urbanizing in an astonishing rate. Its cities are becoming large complex urban agglomerations with many social, economic and environmental challenges. After the 25th of January revolution in 2011, grassroots oriented change to the policies behind local planning and urban development is yet to be seen. The forty years old, new urban communities’ development within the Egyptian desert, is ongoing with a limited success in meeting its three preset goals, to attract population growth away from the Nile valley into the desert, shrink informal growth and limit encroachment on agricultural land. The author of this thesis argues that the project has had its negative reflexes and side effects back on the already built mother cities. Today, the metropolitan Cairo region suffers a high-level of deterioration and dysfunction, there is a substantial loss to fertile land, and more than ever increase in informal sprawl. However, there is no doubt that desert urbanization is still the right solution to tackle the housing problems within the Nile Valley. The questions are how to configure the right model of development, and how to adopt the right policy for sustainable growth?

Owing to its special location, Egypt has been a place for various geopolitical transformations through its modern history. An interesting field of study is to trace back those changes through its corresponding impacts on the local planning and development mechanism. When different ideologies and policies came together to shape the urban setting and configure housing polices.

This thesis is a study with the purpose to change the current Egyptian planning and development policy of desert urbanization. Instead of mainly putting “Theory into practice”, this thesis is comparing “practice by practice” through addressing two models of urbanization in the Egyptian desert. The model of the city Heliopolis (the era between 1905 until 1961) and the new urban communities’ development within the Greater Cairo Region (GCR). The main thesis questions: is could the satellite garden town Heliopolis between 1905 and 1961, be considered as the best urban practice towards sustainable urban growth, in comparison to the new urban communities’ development within GCR? The author has reached the conclusion that the answer is yes. It could be considered based on analyzing the environmental, economic and socio-demographic dimensions of sustainable urban growth.
**Master's Thesis Abstract**

This research aims to map the regulatory framework involved in planning and governing the city components. The main three key questions are:

How does the formal Egyptian urban planning system work? Is the process sectored between different entities or integration occurs during planning? What are the main obstacles in the existing legal and institutional framework?

The dissertation identifies all the central institutions and affiliates involved in urban planning on different levels, in addition to the regional and local administrative system institutional and legal framework.

Infrastructure facilities management is an essential element and one of the main challenges of urbanism. As a result of identifying the authorities, it is found that the utilities management is centralized and several mandates overlap between different institutions.

Public land management comprises complex institutions framework, lack of land policy framework, ineffective land use planning, using old surveying boundaries to control public land.

Finally analyzing the existing institutional framework based on literature and reviewing critical comments from other authors experienced in the Egyptian urban planning field. The main findings of this dissertation are complex institutional organizational structure, highly fragmented legal framework and sectorial planning system and centralization.
Master of Water Engineering

In the last decades, water resources have been under increased pressure, caused by the gap between the need for water and its availability in terms of both its quality and quantity. This is a particular problem in arid and semiarid regions. Beyond traditional sectors where water is in high demand, this phenomenon is being intensified by rapidly growing populations, increased agricultural irrigation for food production, intensified urbanization and climate change. To overcome this dilemma, a water resources management that follows an integrated and interdisciplinary approach is widely proposed, including sustainable capacity building.

Main focal points of Water Engineering are:

- Conventional and advanced treatment of water and wastewater, wastewater discharge systems, decentralized sanitation solutions, water tanks and networks, sludge treatment, sludge disposal and water reuse;
- Engineering hydrology, basic, applied and field hydrogeology, modeling of water related and environmental systems for sustainable exploration of water resources, especially groundwater;
- Biological and chemical aspects of water quality management, including water resource protection;
- Modeling of hydro-systems and hydraulic engineering as well as water and wastewater transport;
- Fundamentals of international water legislation, economics and socioeconomic aspects of water;
- Two project management blocks on “Integrated Water Resources Management” (IWRM);
- Soft skills, intercultural competence and scientific work;
- Practical experience, including work in the laboratory and at test stands, field trips, demo site excursions and an industry internship.
Master’s Thesis Abstract

Sustainable water resource management has become a fundamental global challenge for many countries around the world especially for countries located within the arid and semi-arid region. Egypt as a country lies within the global aridity belt, used to depend on surface water as a main potable water resource. Due to population growth, new settlements, and tourism aspects in the Red Sea district, Egypt has started to explore the potential of groundwater resources especially in the remote areas. The main problem with groundwater in such coastal areas is groundwater salinization or seawater intrusion phenomenon. El Gouna as one of the touristic landmarks along the Red Sea coast is currently experiencing the groundwater salinization because of the groundwater over exploitation from the local aquifers. The average salinity of the city water supply in the beginning was around 4,000 ppm in 1995 and within 19 years, the salinity has risen almost 8,000 ppm to have a present day average of around 12,000 ppm from the same wells.

The objective of this research is to develop a sustainable water management system for the city based on the evaluation of the available groundwater data. The research will interpret the chemical composition of groundwater based on the water bearing type information along with the hydro-chemical signature. The study starts by an overview and general description of the study area, in addition to the geological, hydrogeological and hydrology settings. Moreover, the study includes the flash floods history, geological structure and aquifer system features.

Different data sources were considered in this study; 44-collected groundwater samples, floodwater, rainwater, seawater, and brine water samples. The research is concluded with a data assessment based on visualized data over base maps and several technical diagrams, chemical equilibrium model and hydrochemical coefficients with ion exchange investigation.

The results generally showed more salinity in the eastern and northern part of the study area than the mountain zone. Seawater intrusion influence the groundwater chemical composition in the eastern part of the study area, thus the wells are getting more saline by time. The water-rock interaction is responsible for differentiating between the western and the eastern groundwater in terms of chemistry. The reverse ion exchange is dominating and playing an essential role in developing the groundwater composition in the eastern part because of the sodium high concentration. The speciation calculation by PHREEQC and the Saturation Index values showed that the groundwater flow direction in the eastern part, has been reversed by the over exploration, which means; the groundwater is flowing from the seaside into the study area. The calculations in the western part showed a groundwater flow direction from the south to the north, which means the wells are mainly recharged by wadi Umm Dahiyes.
Master's Thesis Abstract

Aquaculture is the fastest growing food producing industry with an annual growth of 3.2% over the past 50 years. Challenges related to sustainability accompany this growth. Aquaponic systems are derived from recirculating aquaculture systems and hydroponic systems combined. The major problem with aquaponic systems is the energy consumption of the system and balancing of the water chemistry to ensure that the fish as well as the plants receive the nutrients they require. Different methods can be utilized towards energy saving; such as using air lift pumps which can pump the water, allow for carbon stripping and provide aeration for the fish tank and the grow beds. The installation of airlift pumps can reduce energy consumption by 35,100kWh. Further developments in aquaponic systems that can make it greener involves the substitution of conventional water treatment methods with the tricking filter system in the biological water treatment step. This trickling filter treatment step further reduces the energy costs because the water flow is driven by gravity. The trickling filter system is also open to airflow naturally so this further reduces the cost of aeration. Rainwater harvesting in conjunction with municipal water supply can also be incorporated into recirculating aquaculture systems and aquaponic systems; this can reduce the reliance on the municipal water supply by 60%. The added advantage of recirculating aquaculture systems and aquaponics is that is can also be grown close to the point of consumption; in urban areas; with 54% of the world’s population living in urban areas this leads to a reduction in the carbon footprint of the system because the cost of refrigeration and transportation is waivered. In addition to ensure greater sustainability; solar energy can be incorporated into the aquaponic and recirculating aquaculture systems to provide energy for the heating of the water depending on the fish species. The methodology of the study involved extensive literature review; telephone surveys and interviews of the operators of aquaponic systems and recirculating aquaculture systems; site visits and experimentation.
Master’s Thesis Abstract

The use of treated wastewater has become increasingly important in water resources management for both environmental and economic reasons. Interest in the use of treated wastewater, as a substitute for fresh water in irrigation, has accelerated since decades. The challenge of constructing a new wastewater treatment plant for the reuse of the treated wastewater in irrigation or other applications does not face only the high investment cost but also the cost of electric energy needed for operation.

By combination of chemical, mechanical, biological and thermodynamical processes an innovative solution for tertiary treatment of raw municipal wastewater is developed with a focus on net zero energy consumption. Theoretical energy and solids mass balances have been applied for the whole process treating municipal wastewater which is characterized by its low BOD5 concentration of 190 mg/L. The energy balance is positive for electric and heat power which demonstrates that the developed flow scheme is suitable for the treatment of low concentrated municipal wastewater without any external source of electric or heat power. The primary economic evaluation shows lower operational and investment costs in comparison to the conventional wastewater treatment plants in combination with a smaller footprint. However, a full economic study should be performed as a next step to quantify the economic benefits of the developed scheme.
**Master’s Thesis Abstract**

A trouble-free operation of a Wastewater pumping station is directly related to the problem of sedimentation inside its Wet well. This problem, if neglected, shall lead to high cost of maintenance and energy consumption. This thesis studies the effect of an innovative design of an inlet of a large Wastewater pumping station on the sedimentation problem. The computational Fluid Dynamics CFD results of five operation points during Night, Day, Storm and Flushing were found to be in good agreement with the preliminary physical model test. Furthermore, a design enhancement is proposed based on the observed distribution of velocities inside the Wet well. This design enhancement proposes the reduction of the sump inlet diameter from 1400mm to 1000 mm in addition to its rotation towards the longitudinal direction of the sump where a dead sedimentation zone was detected in both CFD and Physical experiment results.

The new design of Biesdorf station is not a typical Trench-type wet well neither a typical Rectangular one according to the geometries provided by the American national standard for Rotodynamic Pumps for Pump Intake Design ANSI/HI 9.8-2012. This does not mean noncompliance, since the standard clearly states that in case of different design geometries, if a prototype testing or a physical model study is performed in accordance with the standard and shown to meet its acceptance criteria, then it shall be deemed to comply with the standard.

In a larger scope, the results of this thesis are supporting the steps towards covering the gaps mentioned in ANSI/HI 9.8-2012; where there is a lack of available correlations between computational Fluid Dynamics CFD simulations and experimental results. However, it asserts that the advances in CFD indicate that the Hydraulic Institute may consider additional applications of CFD in future revisions of the standard ANSI/HI 9.8-2012.
Master’s Thesis Abstract

The purpose of this work is the evaluation and subsequent improvement of the overall treatment efficiency of the municipal wastewater treatment plant (WWTP) located in El Gouna, Red Sea, Egypt. The WWTP of El Gouna consists of three separated treatment units; all of them operating on the basis of the conventional activated sludge (with aeration) process and is capable of treating up to 3000 m³ of sewage per day. Each treatment unit consists of three separated streams, whereas at one of the streams of each unit, biofilm carrier material has been added in the aeration tank. The treated water is used to cover partially the irrigation needs of El Gouna.

For this purpose, the following parameters were monitored during a period of 5 months: In the main inlet and outlet samples the parameters pH, conductivity, temperature, COD, BOD, solids (total, suspended, dissolved), nitrogen compounds (i.e. NH4-N, NO3-N, NO2-N, total N) and phosphorus. Additionally, in the samples from the aeration tanks dissolved oxygen, MLS, MLSS and the respective volatiles and the sludge volume index (SVI) were determined. For comparison reasons, samples were taken also separately from the direct outlets of the aeration tanks with and without carrier material. Several elements were also determined in selected samples (Ca, Fe, K, Mg, Mn, Na).

The results were used to evaluate the WWTP’s treatment efficiency and its response to the seasonal variations of El Gouna’s visitors’ number and of the ambient temperature, with the aim of the WWTP’s operational optimization. The operational problems resulting in relatively high fluctuation of the effluent quality were detected and several measures were considered and proposed. The measures were focused on the improvement of fats and grease removal efficiency, optimization of the aeration conditions and of suspended solids concentration in the aeration tanks and of the nitrification process. The Egyptian standards of water reuse for irrigation purposes were taken into consideration regarding the effluent quality. Finally, considerations were also made regarding the decrease and optimization of the energy consumption during treatment.
Master's Thesis Abstract

The research is assigned to investigate appearance of strange corrosion in the beach wells equipment especially the submersible motors. The wells are in running since 2002 without appearance of this strange corrosion. Since 2009, localized corrosion appeared on the motor outer surface with clear signs for bio-corrosion. Field survey had been executed including collecting of samples for chemical and microbiological analysis. Results and data analysis showed existing of bacteria causing the bio-corrosion, the bacteria exists due to spoiling of ground water. Preventing the spoiling and sequential periodical check for the well equipment shall decrease the corrosion rate and restore the normal equipment life-time.

Organic contamination in the Karst terrains is a considered source, many human activities took place in the mountains area beside the small undeveloped Bedouin settlements. Absence of proper cycle for solid and domestic waste treatment in this area may lead it to be a source contamination especially after seasonal events like flooding which can leach these wastes and spread it widely in the area to be infiltration through bores and fractures.