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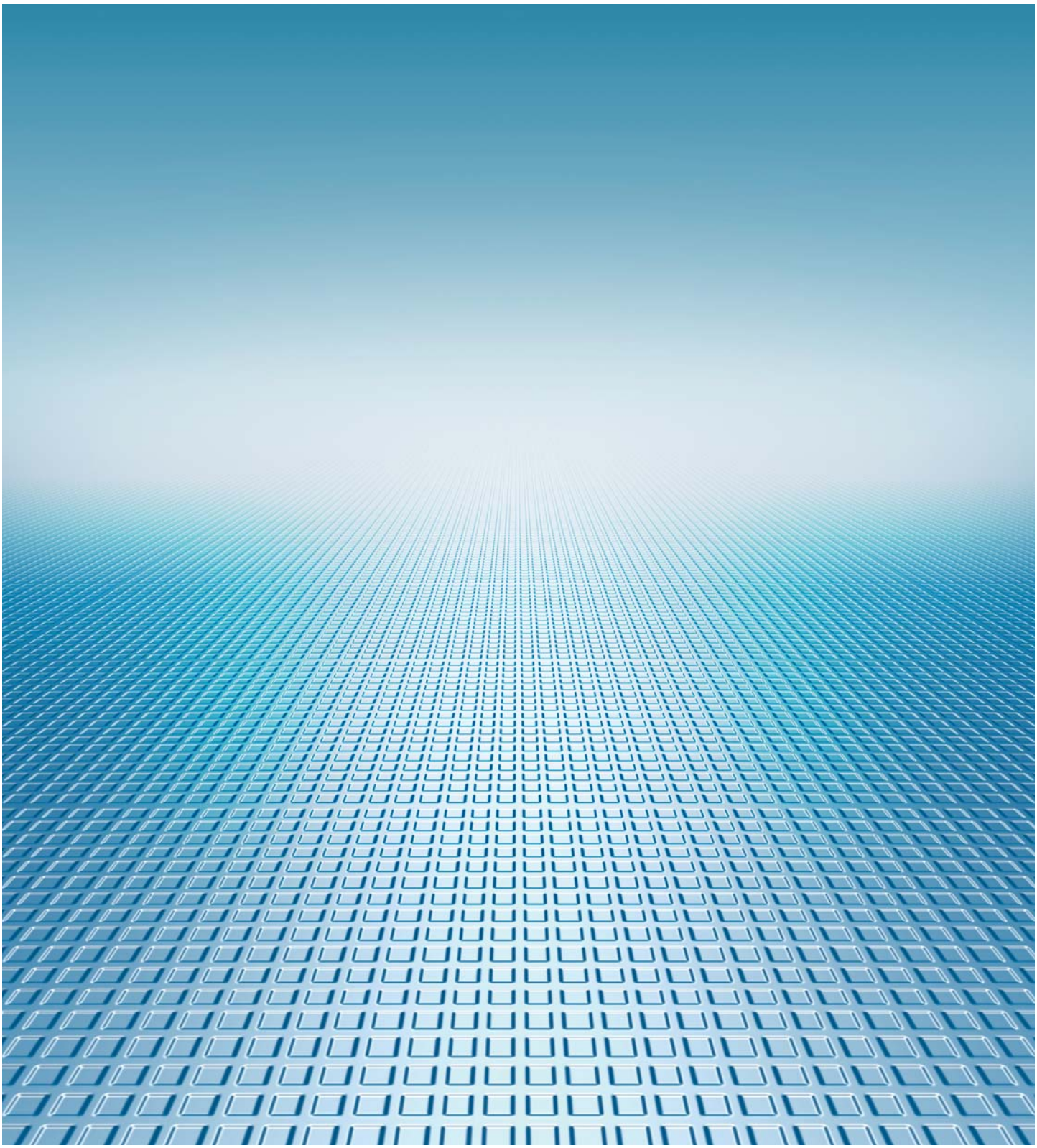

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On the publication of "Global Resource Management" (GRM Journal)

Akihiro Ametani
Editor, GRM Journal
Professor of Graduate School of Science and Engineering

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Editor, GRM Journal
Associate Professor of Organization for Advanced Research and Education

In the autumn of 2012, the "Global Resource Management" (GRM) program proposed by Doshisha University was selected to be one of the Leading Graduate School Programs financially supported by the Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT).

Since then, the faculty members and administrative staff of the GRM program have worked hard to establish all the necessary rules, curriculums, and offices. We were able to begin the first semester with eight Ph.D. students and twenty-one M.Sc. / M.A. students in April 2013.

This journal aims to inform readers of our GRM activities and to publish research and academic papers related to GRM topics. The journal is composed of the following items:

1. News related to the last year's GRM activities
(a) Course activities, (b) symposia and conferences, (c) lecture series and seminars, (d) the Global Leadership Forum, (e) on-site practice, (f) internships and field work
2. Invited papers
3. Selected papers written by GRM students produced as a result of their GRM coursework
4. Research and academic papers related to global resource management

Should you have any ideas about how to improve the journal, we certainly welcome your comments and suggestions. We are quite sure that they will help us to improve our fledgling publication.

Message

Koji Murata, Ph.D.
President
Doshisha University

Welcome to Doshisha University's Global Resource Management (GRM) Program. We are very proud to publish this new journal from the GRM program. Recently, Japan's higher education institutions became strongly committed to educating the aptly named "Global Human Resources" or *Global Jinzai.* Our GRM program is a part of this effort.

Why should we educate "Global Human Resources" in Japan today? Why should they be educated at Doshisha University?

Let's discuss the first question: "Why should we educate them in Japan today?"

Japan remains the third largest economy in the world. One cannot discuss world politics or economics, especially those of East Asia, without talking about Japan. Japan is currently struggling with a number of constraints and stresses on its system, such as a declining birth rate and an aging society; these are issues that many other countries in the world will, in all likelihood, also experience eventually.

To explain this a bit deeper: Not only is Japan a "developed" nation, it also happens to be the country in which the problems that plague developed nations *first arise*. Japan was also one of the very first Asian countries to actively adopt Western culture and to develop as a hybrid of both the East and the West.

Now, to address the second question: "Why educate them at Doshisha University?" Japan has hundreds of universities – as many as 780 nationwide. Yet even among so many other universities, Doshisha University offers something truly unique.

Doshisha has three characteristics that make it an exceptional university:

First, Doshisha University is located in Kyoto. Nearly 40 percent of all Japanese students attend universities in Tokyo and the surrounding region. A vast concentration of students live and study in and around our capital city. Of course, there are many advantages of going to a university in a metropolis. However, we should not forget that the majority of the world's population does not reside in capital cities. Therefore, it is extremely important that intercultural exchanges take place in areas outside of our capital city as well as within it. Most of all, I firmly believe that there is a profound significance in being able to spend one's youth in Kyoto, a city in which tradition has historically co-existed with a spirit of innovation.

Second, Doshisha University is a private, and therefore independent, university. The educational philosophy of Doshisha University's founding father, Joseph Hardy

Neesima (Jo Niijima), continues to thrive on our campus. At the time in which the Meiji government was attempting, in its policy of *wakon yosai* ("Japanese spirit with Western technology"), to adopt the technologies and systems of the West for the sake of modernization, without truly understanding and incorporating Western ways of thinking, Neesima argued for the vital importance of a civil society that supported Western technologies and systems. He devoted himself to developing independent-thinking, intelligent citizens who could comprise this civil society; he strived to educate people who, as he described them, could "make decisions and take actions on the strength of their own conscience." Neesima's emphasis on the importance of developing a civil society is an example that surely many countries still take to heart.

Third, Doshisha University has always made Christianity the foundation of its education. At Doshisha University, we do not require that all our students be Christian believers. We know that Christians have only comprised a mere one percent of the Japanese population, since the Meiji period through today. At the same time, the number of Christians worldwide has now reached 2.2 billion. The ability to look at social phenomena from a Christian perspective, and to have a basic understanding and knowledge of Christian teachings in Japan today, is an exercise in understanding what it is to be a minority and thus have an appreciation for the importance of tolerance, while also being part of a majority and linked with others in a global world. As if to prove this, on our campus, Christianity, Islam, Buddhism, and Shinto exist together in harmony.

It is the combination of these distinctive characteristics—our location in Kyoto, our status as a private university, and the Christian beliefs that lie at the heart of the education we offer—that makes Doshisha University a truly superb and unique place to study. Underlying these characteristics are three qualities essential for leading a productive and engaged life in the globalized world of the twenty-first century: an appreciation of diversity, a spirit of tolerance, and respect for individual conscience. Amongst Doshisha's traditions, there is something that is extremely contemporary which speaks to life in the modern world.

With these unique characteristics and qualities, Doshisha University aims at educating beyond the "Global Human Resources" and focus on developing "Glocal (global and local) Human Characters" or *Glocal Jinbutsu.* "Glocal Human Characters" possess three qualities, in addition to a command of English and a deep understanding of religion. First, they are empathetic towards diverse cultures and values. Second, they are inquisitive about universal truths. Third, they engage in self-reflection. In this regard, Neesima was a great model of the "Glocal Human Characters" of today.

Doshisha University has a well-established tradition of collaborating with esteemed higher education institutions from all over the world, including Amherst College

(Neesima's alma mater), Stanford University, and Tubingen University in Germany, among others. Please join us in helping to educate the "Glocal Human Characters" or Neesimas of the twenty-first century.

Thank you very much.

Message

Masanori Naito
Program Coordinator
Dean of the Graduate School of Global Studies

Doshisha University's Global Resource Management (GRM) Program has been selected as part of the 2012 Japan Ministry of Education, Culture, Sports, Science and Technology (MEXT) Program for Leading Graduate Schools, under the category of interdisciplinary programs for a harmonious multicultural society. Under the aegis of MEXT, the Program for Leading Graduate Schools promotes and supports profound reforms in graduate education. Graduate schools that develop and implement world-class comprehensive doctoral programs that go beyond the boundaries of an individual specialized field of study are supported by the Program. Participating graduate schools bring in outstanding domestic and international faculty and students, and develop creative leaders who possess a broad perspective and can work across different industries, educational fields, and government departments on a global scale.

The GRM program is an advanced interdisciplinary doctoral program in global resource management, in which students taking global studies as a major take science and engineering as a minor. The areas of study in engineering include infrastructure, science and resource, and energy science. Conversely, students majoring in science and engineering take a sub-major in global studies. The GRM program fuses humanities, social sciences, engineering, and the natural sciences. The Graduate School of Global Studies and the Graduate School of Science and Engineering are the core graduate schools forming the GRM program. However, students from other collaborating graduate schools may also enroll in the program, subject to meeting the program requirements.

The GRM program is also a comprehensive doctoral program that provides advanced education in the interdisciplinary field of global resource management through the integration of global studies and infrastructure, resource and energy science. These fields form the very foundation of human society and security. The program aims at fostering global leaders who possess a tenacious spirit and high ethical standards, and are highly capable of partnering with and taking action in the most troubled regions and developing countries. The ideal leaders GRM aspires to develop will have the following skill-sets:

1) To be able to work and learn alongside people facing life-threatening situations, such as disasters, conflict, and poverty, and to formulate solutions that will alleviate such suffering;
2) To be able to integrate the natural and social sciences;
3) To be able to promote religious and ethnic harmony based on fairness, equity and empowerment through the integration of engineering and science

with the humanities, and to prevent fresh conflict and promote recovery and development from existing conflict; and
4) To be able to form strategic partnerships with people and communities in developing countries who have overcome their struggles through the promotion of sustainable and inclusive development.

Today, East Asia, Southeast Asia, Central Asia, and the Middle East are experiencing significant economic growth, and many of the countries in these regions have growth rates that are at par with or close to those of G-20 members. One unique feature of the GRM program is our targeting such developing countries. In addition, the program aims to find suitable career paths for our highly trained Ph.D. graduates in these countries. By directly participating in efforts to move from a state of struggle to a path to development, GRM graduates are expected to gain knowledge and experience which will also help the development of Japan in the future. Many of these particular developing countries, the so-called Next Eleven countries, and the most troubled regions and countries have a high proportion of Muslim inhabitants. The Doshisha University is well equipped for this, with the standard of interfaith dialog and research conducted at the University's Center for Interdisciplinary Study of Monotheistic Religions (CISMOR) amongst the most developed in Japan.

In order to bring about positive breakthroughs to a world currently experiencing weak economic growth or even stagnation, a new kind of infrastructure that unifies the physical, social, and spiritual dimensions need to be created. To accomplish this, the GRM program provides a doctoral education that integrates the university's well-established educational system in the realm of natural sciences and engineering with respect to energy and resources with the educational system for humanities and social sciences with respect to the co-existence of different cultures. Taking from the domains of natural science and engineering, the topics of electricity, energy, information, transportation, and water resource management will be included in the program. From humanities and social sciences, we incorporate aspects of our world-renowned multicultural integration research program, as well as our programs covering the topics of human-security assurance, conflict deterrence, peace-building, development, policy science, governance, sociology, social welfare, and a number of other areas. In particular, the program will emphasize co-existence with Islam as one of the major issues towards realizing a harmonious multicultural society – another unique characteristic of the program.

Although the development of global leaders is part of Japan's educational policy, the image of the ideal leader developed by the GRM program is unique to our university. Our ideal leaders will not be modeled on pre-existing successful leaders, and it is certainly not the program's intent to develop monarchs or traditional leaders. Breaking with Japan's stagnation will be challenging if the focus remains only on Japan itself, where the birth rate is already very low. By working alongside people in developing countries that have a large youth population, such as Indonesia, Turkey, and China, GRM students and graduates will absorb the energy of these people and eventually contribute to a re-energizing of Japan. Ideal GRM global leaders will also gain the knowledge necessary to tackle global issues by working alongside people

living in countries and regions facing extreme difficulties. Furthermore, they will also strive to formulate and implement realistic solutions. The program plans to focus on Afghanistan in particular, where the university has already been involved with peace-building activities, and also in the Gaza Strip, one of the most troubled regions in the world.

In order to enroll in the GRM program, a student must either be enrolled in the Graduate School of Global Studies or in the Graduate School of Science and Engineering. A student may also be accepted if he or she joins either one of the graduate schools mentioned above and takes an area of specialization accepted by a faculty adviser affiliated with the program. International students can also enroll subject to meeting the program entry requirements. Students are to follow the guidelines of their respective graduate school to obtain a degree. In addition, humanities and social science majors must complete at least 20 credits of science and common courses, and science majors must complete at least 20 credits of humanities, social sciences, and common courses. In developing countries and emerging countries, those with only an educational background in humanities or social sciences, or those with only a science or engineering background bound by what they can contribute towards development. Even if a corporation has succeeded in expanding globally through its excellence in science and engineering, it cannot promote multicultural harmony without good management and governance practices, and moreover, without considering its social responsibilities. Similarly, a person well versed in the humanities and social sciences will not be able to contribute effectively to society without any knowledge of energy and resources, or of the physical infrastructure that forms the basis of human society. The GRM Program for Leading Graduate Schools specializes in developing within students both a scientific understanding of energy, resources, and infrastructure, and an understanding of the humanities and social sciences with respect to social responsibility and implementing good management practices. Through such comprehensive doctoral education, GRM students will gain strong support for the establishment of integrated multicultural societies around the world.

As GRM students progress through their five-year doctoral program, we hope that they will consistently strive to make positive contributions as responsible global citizens. We are currently planning to give special grants to students who complete the first half of the GRM doctoral program to cover some of the costs for international internships and fieldwork. The GRM Program for Leading Graduate Schools is not intended to produce highly specialized researchers, but rather Ph.Ds. who can assimilate knowledge from various disciplines to promote sustainable development and multicultural harmony.

The First GRM Symposium

Date: March 9, 2013 13:00–17:00
Venue: M21 Meitokukan, Imadegawa Campus, Doshisha University

1. Timetable

Keynote Speeches

1. "Future Development of Doctoral Programs and the Role of 'Program Graduate Schools'"

Shinjiro Komatsu (Director-General, Private Education Institution Department, Higher Education Bureau, Ministry of Education, Culture, Sports, Science and Technology, Japan)

2. "Multiculturalism and Education for Global Leaders"

Masanori Naito (Professor, Graduate School of Global Studies, Doshisha University)

3. "Globalization and Safety Management"

Tsukasa Uemura (Ministry of Foreign Affairs of Japan)

4. "Development in Africa and Global Relationship"

Jinichi Matsumoto (Advisor at the Asahi Shimbun)

5. "Current World Affairs: Perspectives of an International Correspondent"

Yasuhiro Nagasaki (Director General, NHK Kobe)

Panel Discussion

"The Present State of Interdisciplinary Advanced Doctoral Programs in Other Countries"

"The State of Infrastructure in Other Countries and the Expected Role of Global Resource Management"

Panelists:

Park Jong Keun (Professor, Seoul National University)

Carlo Alberto Nucci (Professor, University of Bologna)

Matti Ilmari Lehtonen (Professor, Aalto University)

Unnur Stella Gudmundsdottir (Energinet.dk)

Silverio Visacro Filho (Professor, University of Minas Gerais)

Haruyuki Shimada (JICA)

Masanori Naito (Professor, Graduate School of Global Studies, Doshisha University)

Chair: Akihiro Ametani (Professor, Graduate School of Science and Engineering, Doshisha University)

2. Overview

In the opening of the symposium, contemporary world issues and expectations for the Global Resource Management ("GRM") program in solving those issues are addressed. In today's world, conflicts occur because of inequalities in the basic infrastructure for human life, such as electricity, water supply, transportation, and information. Differences of ethnicity and beliefs are not a source of conflict. Throughout history, people with many different backgrounds coexisted. It is since the formation of the modern nation-state system that inequality among states and among people has increased.

Until now, social science and natural science have been taught separately. We have not had a chance to learn both at the same time. In GRM, our objective is to understand specific problems by moving beyond the dichotomy of state and private enterprises and social and natural sciences. The GRM program seeks to address these issues and strives to realize a harmonious coexistence of multiple cultures by providing solutions founded on sustainable development, human security, and a fair and reliable distribution of resources. In order to bring about positive breakthroughs to modern-world issues, we need to overarch existing ideology and methods, unifying the physical, social, and spiritual dimensions.

Students in and graduates of the GRM program are expected to visit or stay in unstable regions that are at risk of disaster, war, and disease for their research or for their jobs. Safety management in such regions is demonstrated in the next lecture. The importance of a deep understanding about the region, its language, and human network are emphasized.

In the last two lectures, the impact of globalization in Africa and information literacy to understand current world affairs were presented. When one perspective sweep away other perspective, it is important to keep distance from such main perspective and reconsider from several other perspectives to understand current world affairs.

In the discussion, a system of higher education and the conditions of infrastructure in each panelist's country were presented. Each of those countries aims to develop renewable energy, reduce consumption, and secure self-sufficiency of energy resources. These tasks require knowledge and experience in both social and natural sciences. The GRM program is expected to develop such a human resource that can work in both fields.

(Takuya Moriyama, Doctoral Student,
Graduate School of Global Studies)

Lecture Series 1

Date: February 4, March 8, 10, 19, 2013
Lecturer: Prof. M. T. Correia Barros, Prof. Silverio Visacro Filho,
Prof. Carlo Alberto Nucci, Prof. Jong Keun Park,
Prof. Matti Ilmari Lehtonen, Dr. Unnur Stella Gudmundsdottir,
Prof. H. Griffiths, Dr. P. Yutthagowith
Title: Energy Policies and Infrastructure in the World

1. Energy Policy and Infrastructure in Portugal

Lecturer: Prof. M. T. Correia Barros, Technical University of Lisbon, Portugal

Date: February 4, 2013

Overview: In Prof. Barros's presentation, a discussion about the commute by car between two cities or areas is quite interesting. In Japan, the commute between very big cities, such as Tokyo and Osaka, is very short. However, that between Akita and Sendai is much longer, although the distance is far smaller. As part of a country's basic infrastructure, the idea of commute time has to be studied from the viewpoints of policymaking, economy, social benefit, and welfare.

2. Energy Development in Brazil

Lecturer: Prof. Silverio Visacro Filho, Federal University of Minas Gerais, Brazil

Date: March 8, 2013

Overview: University education in Brazil is quite different from that in Japanese universities because the country is very large and the natural environment is very different in each area. To develop the country effectively, even an engineering student has to learn social and human science. This education is quite similar to the GRM program in our university.

3. Energy Policy and Infrastructure in Italy

Lecturer: Prof. Carlo Alberto Nucci, University of Bologna, Italy

Date: March 8, 2013

Overview: Italy is very similar to Japan in its natural environment and energy resources. Italy needs to import electric energy, but it has no nuclear power station. With respect to the country's energy independence, policy discussions are ongoing, and no conclusion has yet been reached.

Lectures by Profs. Silverio Visacro Filho and Carlo Alberto Nucci

4. Energy Policy and Smart Grid in Korea

Lecturer: Prof. Jong Keun Park, Seoul National University, South Korea

Date: March 8, 2013

Overview: Korea is very similar to Japan in its natural environment and energy resources. It is also operating many nuclear power stations to retain its energy independence and industrial development. There was a large blackout in Korea last year, causing much criticism of the government by its people.

Lecture by Prof. Jong Keun Park

5. Energy Policy and Infrastructure in Finland

Lecturer: Prof. Matti Ilmari Lehtonen, Aalt University, Finland

Date: March 10, 2013

Overview: As one of the most advanced countries in terms of its ecology (environmentally friendly) and social welfare, Finland's policy about electric power is quite interesting. Contrary to our expectations, Finland has decided to carry on with nuclear power generation because of demand from industries for cheap electricity and for export. Finland's energy policy is not straightforward at all.

Lecture by Prof. Matti Ilmari Lehtonen

6. Energy Policy and Infrastructure in Iceland

Lecturer: Dr. Unnur Stella Gudmundsdottir, Energinet.dk, Denmark

Date: March 10, 2013

Overview: Dr. Stella is originally from Iceland, which is situated in a very severe climate environment, but is rich in energy usage. Its electric energy is entirely renewable and sustainable. It comes from geothermal and hydraulic resources. Iceland's electricity consumption per person is one of the highest in the world because it is very cheap and the country has sufficient electricity generation.

Lecture by Dr.Unnur Stella Gudmundsdottir

7. Energy Policy and Wind Power Generation in the UK

Lecturer: Prof. H. Griffiths, Cardiff University, UK

Date: March 19, 2013

Overview: The UK is going to construct wind farms to replace nuclear power stations in the next 30 years.

Lecture by Prof. H. Griffiths

8. Energy Policy and Infrastructure in Thailand

Lecturer: Dr. P. Yutthagowith, King Mongkut's Institute of Technology, Ladkrabang, Thailand

Date: March 19, 2013

Overview: Thailand is developing power generation because of increasing energy consumption. Electricity is a key element for industrial and social development of the country. However, it is not easy to maintain the power systems because of the natural environment—very hot and humid, since Thailand is a tropical country, with floods due to heavy rainfall all year.

Lecture by Dr. P.Yutthagowith

(Keisuke Nakamura, Master's Student, Graduate School of Electrical and Electronics Engineering)

Lecture Series 2

Date: May 10, 2013 15:00–16:30
Venue: Chapel, Imadegawa Campus
Lecturer: Dr. Salahuddin Wahid (Leader of Nahdlatul Ulama, Indonesia)
Title: Social Activity of Nahdlatul Ulama: Coexistence of Plural Communities through Empowerment of Local Communities

[Overview of the Lecture]

1. Introduction

After 9/11, prejudice toward Muslims is increasing around the world, especially in the West. One of the countries that play a critical role to improve the situation is Indonesia, which promotes pluralism and moderate Islam.

Indonesia holds the largest Muslim population in the world. Nahdlatul Ulama ("NU"), which promotes moderate Islam, is the biggest Islamic NGO in Indonesia. It is followed by Muhammadiya, which emphasizes more modernized Islam. In East Java (Java), NU related organizations exist and are active in every level of society, including the rural areas.

Indonesia is a country that has been pursuing unity in diversity. However, many people now question whether Indonesians will remain moderate Muslims or become more radical in the future. Indeed, there are radical Islamist groups in Indonesia.

2. Historical Background

It is important to know the historical background to analyze the current situation and tendency in the future. Indonesia consists of different races, ethnicities, religions, and cultures with different backgrounds and origins. These various factors have coexisted for centuries. Before Islamization of the region began around the 15th century, Indonesia already had a foundation of pluralism that respected different cultures or thoughts.

Wali, a Muslim intellectual, played an important role in spreading teachings of Islam. Wali respected the local customs, which were dominated by Hinduism and Buddhism. Under this circumstance, Muslims were able to develop mutual respect, understanding, and tolerance of others. Pluralism is the main feature of Indonesia.

3. Establishment of Nahdlatul Ulama

On January 31, 1926, NU was founded in Surabaya (the capital of East Java Province) to form a new organization to accommodate and coordinate local ulamas (Islamic religious scholars) in Indonesia with the wide cooperation of local traditionalist ulamas. The NU succeeded because it had the support of the local Pesantren (Islamic boarding school), and it made the best of this existing network.

In 2001, according to statistics provided by the Ministry of Religious Affairs, more than 40% of Muslims in Indonesia borrowed the ideas of NU, but they were not necessarily involved in NU as a member. NU follows the following basic principles: (1) moderate attitude; (2) maintenance of harmony; and (3) balance in everything, including using rational justifications based on the Qur'an (the holy book of Islam) and Sunnah (the words and/or activity and/or attitude of the prophet Muhammad, which is accepted by Muslims as the second highest source of law after the Qur'an). NU tries to promote generosity, mutual understanding, and cooperation beyond ethnicity, language, culture, politics, and religion. It tries

to do so by empowering local communities while focusing on three basic elements: human relations, relations with the state, and relations with other Muslims.

4. Tolerance as a Part of Religious Teaching

Tolerance, a characteristic of NU, was subject to a new interpretation. Here, tolerance becomes part of the religious teaching of Islam. As mentioned in the Qur'an, we cannot force our own belief on anyone, especially by using any force or violence. If by any chance we see some people using violence in the name of religion, they are actually doing that based on their own interest, not because of religion.

Many of the members of NU are activists as well, promoting human rights, community development, and inter-faith dialogue. NU has established a good relationship with other religions based on networking at a grassroots level.

After 1984, NU resigned from the political arena and focused on social activity, especially primary education, by establishing Pesantren. The number of Pesantren has increased over the last five years. However, the quality of Pesantren needs to be improved so that competitiveness will increase and the schools can face the challenges of globalization.

In order to prevent conflict and develop the rural areas, where people are marginalized by the government, NU and its related organizations conduct various activities to empower local society.

5. Challenges to Pluralism

Indonesian people are generally moderate, but there is an undeniable tendency that support for religious conservatives is also increasing. An attitude of intolerance is increasing, as is the number of violent attacks. Some groups justify the violence. Among the religious conservative groups, it seems social pluralism is accepted but religious pluralism is rejected. Islam is a religion with no distinction of race or color, whether civilians or soldiers, rulers or subjects. We have to note that pluralism itself is not against the teaching of Islam.

(Naomi Nishi, Doctoral Student,
Graduate School of Global Studies)

Lecture Series 3

Date: July 17, 2013 18:00–20:00
Venue: SK119, Shikokan building, Karasuma Campus
Lecturer: Dr. Ko NAKATA (Former Professor of Doshisha University) and
Mr. Kosuke TSUNEOKA (Freelance Journalist)
Title: The Current Situation of Syrian Conflict (Lecture in Japanese)

Prof. Naito, Dean of the Graduate School of Global Studies, mentioned at the opening of the lecture that the conflict in Syria is the biggest humanitarian crisis in the twenty-first century. It is impossible to send GRM students to Syria at present, but the time when they will think about the post-conflict era of Syria will come in the future. Thus, it is important to know the current situation of Syria through the people who experienced the place where the conflict is going on.

1. The Lecture by Mr. Kosuke TSUNEOKA

Mr. Tsuneoka visited the area in Syria that is under the control of the anti-government group as an illegal entrant, but he stayed there for about 18 days and interviewed the group. A Turkish NGO, The Foundation for Human Rights and Freedoms and Humanitarian Relief (IHH in Turkish), helped him to enter Syria. He interviewed soldiers who belong to Nusra (Syrian Al-Qaeda), an anti-government and foreign volunteer soldiers' group. The Nusra soldiers are mainly Turkish and Arabian. Mr. Tsuneoka wanted to take some photos of them, but he could not because they might be arrested in their mother countries when they go back there. However, some of them allowed him to take photos.

When Mr. Tsuneoka entered Syria, he was lost and met Nusra. It was a dangerous situation, but the soldiers of Nusra contacted the volunteer army so he could reach the army. While he was with Nusra, he could communicate with the leader (not the commander), an Iraqi. Nusra has tried to change Syria to a Caliphate because presently, Syria is secular and Islam is not understood well. They would like to be a good example of Islam and try to introduce Islam to Syria little by little. Nusra is not anti-USA, but their enemies are the Assad regime, Iran, and Ḥizb Allāh. In addition, Nusra thinks that to defeat the Assad regime, they must also fight against Russia.

There are many Chechens in the anti-government groups in Syria. They did not come to Syria directly from Chechnya, but via European countries such as France, Germany, Belgium, Austria, and Sweden. They speak Russian or German when they communicate each other. Some Chechens entered Syria, Turkey, Lebanon, or Jordan as refugees or immigrants. In the case of the Chechens in Syria, they are fighting against the Syrian government as members of anti-government groups.

It seems that Chechens like to live in Syria because Muslims, especially Salafi Muslims, are criticized in Europe and member states of the former Soviet Union, such as Kazakhstan and Uzbekistan. They are sometimes unjustly arrested, and therefore escape from their countries to Syria. Salafism is known for being affiliated with Al-Qaeda in the Arabian Peninsula, but they do not think they are Al-Qaeda. They are trying to establish a nation based on Salafism in Syria. If they win the conflict against the Assad regime, they do not intend to cooperate with the regime. They will not disarm them. Some of the Salafist groups do not insist on the establishment of a Caliphate.

The anti-government groups have weapons, especially automatic rifles. They also have enough money. The Syrian government forces attack them from high altitudes to prevent attacks on the ground by anti-government groups. Thus, many citizens are victimized. There was an intense battle in Jabal al-Turkman, where Mr. Tsuneoka conducted interviews.

2. The lecture by Dr. Ko NAKATA

Dr. Nakata stayed in Syria for three days and made contact with a Salafi group organized by Jordanians, Tunisians, and Egyptians, among others. There are movements to revive the Caliphate, though such movements were not seen more than 20 years ago. The Salafi group does not have anti-USA sentiment, but is, rather, Syrian government and its ideology--that is pan-Arabism.

Dr. NAKATA visited Al-Bab, which was under the control of a Salafi group with a black banner, but there was a Syria National army presence as well. The anti-government group is organized mainly by Jabhat or Nusra. These two groups are suspected by the USA of having a relationship with Al-Qaeda, so the USA would not like to support the anti-government group. However, the government of Syria will win the conflict if the USA does not support the group.

There was a shortage of weapons when Dr. Nakata visited Al-Bab. NGOs and other groups are not providing weapons to the anti-government group, so weapons are made by hand. These weapons, especially trench mortar guns, are produced at a rate of about 80 per day. Explosives are procured from unexploded bombs and dug up land mines that were buried by the UK army during World War I.

(Toshie Inui, Doctoral Student,
Graduate School of Global Studies)

Lecture Series 4

Date: July 11, 2013 17:00–18:30
Venue: SK110, Shikokan building, Karasuma Campus
Lecturer: Dr. Wu JiNan (吳寄南) (Director and Senior Fellow of the Department of Japanese Studies, Shanghai Institutes for International Studies)
Title: Improving the Japan-China relationship (Lecture in Japanese)

1. Overview of the Lecture

In the lecture, China's outstanding issues since its economic reform and breakthrough of the Japan-China relationship were presented. Chinese economic reform is still evolving, fighting with vested interests. While it is very hard to achieve, dissolving vested interests is the key for reform projects.

Today is a turning point for the conventional pattern of development and economic growth. In China, huge amounts of resources such as construction materials, fossil fuels, and mineral resources are being consumed. There is also serious environmental pollution. China's emission of carbon dioxide is the largest in the world today. In addition, China is facing many other issues, such as economic disparity between large cities and rural areas, human rights violations of farmers who migrated from rural areas to large cities, political corruption, and an ethnic minority problem. As a superpower, more contributions to international society are also required.

Under the Xi Jinping government, deregulation and an international cooperative policy have brought good results. For its strategy to achieve more growth, construction of infrastructure such as housing, waterworks, highways, and rapid-transit railways as well as development of private sector capital and human resource development is necessary.

The territorial conflict in the Senkaku Islands is affecting the China-Japan relationship adversely. On the other hand, because of intensified economic interdependency, China and Japan need each other. Other countries, especially the United States, do not allow the deterioration of China-Japan relations. The China-Japan relationship is more than that of a married couple—they cannot divorce. A risk management system, the promotion of cultural exchange among intellectuals and civilians, and the closest economic ties are necessary to achieve a better relationship. The role of the media in providing correct information on the counterpart country is also being emphasized.

2. Outcome

China is experiencing both rapid growth and increasing social issues, such as economic disparity and environmental pollution. These contemporary issues are difficult to resolve by one country alone. Because Japan is a frontrunner in solving these contemporary issues, Japan and China can cooperate, using their experience and technology. It is important to propose a new model in the post-growth society.

China and Japan must develop a crisis prevention system for territorial conflicts. In addition, public and private interaction and efforts toward mutual understanding are necessary. The role of the media is especially important. Since news reports strongly affect national image, the media must avoid creating and propagating a negative image of the counterpart. Multifaceted viewpoints and information, including that on daily life and culture, must be shown. Mutual understanding among citizens through exchange in education, economics, and culture will be a strong base for the China-Japan relationship to develop favorably.

(Takuya Moriyama, Doctoral Student,
Graduate School of Global Studies)

Lecture Series 5

Date: September 27, 2013 13:30–16:30
Venue: Meeting room, Shikokan building, Karasuma Campus
Lecturer: Mr. Taha Özhan
(President of SETA, Foundation for Political, Economic and Social Research)
Discussants: Mr. Ufuk Ulutaş and Mr. Talip Küçükcan (SETA)
Title: Comparison of the process of democratization in Turkey and Egypt

1. Summary of the Lecture

Tahrir Square became a symbol of street protests, where parliamentary process was ignored at the parliamentary level. The military regime did not ignore the potential of Tahrir Square. Thus, the square turned into an instrument of the military to interfere in the political process. From a revolution to a coup, Tahrir was at the center of Egypt. Since February 11, 2011, the military decided to carry on with their grip on power and on the country without ex-president Mubarak. The establishment maintained Mubarakism without Mubarak.

The Egyptian political system has been used in military and judiciary interventions many times over under the tutelage of the Supreme Military Council. The parliamentary elections took place despite the obstacles presented and engineered by the establishments of the military and judiciary. It took two and a half months to complete the elections successfully. For the first time, all segments of society were presented in the parliament, from Islamists, secularists, Salafists, leftists, and so on. The military did not seem to care much about parliamentary elections. Liberals misunderstood that by thinking that the military was beginning to accept democracy. However, the military made a blunt intervention through an administrative court to abolish the constitution-making committee. The reaction by the Egyptians was modest against a very serious event. Another intervention by the military, but this time through the judiciary, was to cancel the presidential nomination of the Muslim Brotherhood's candidate, Mr. Khairat Al Shatter. Al Shatter was not in prison and he was the de-facto leader of the Muslim Brotherhood. He seemed to be the only leader who could move the country forward. Al Shatter's candidacy was canceled and therefore a new candidate, Mohammad Morsi, was introduced. The third serious intervention was the dissolution of the parliament on June 14, 2012, again using the judiciary. That was a serious indication of what was coming in the future. The opposition secularists celebrated the decision. They thought they were beginning to get rid of "Islamists." Egypt found itself in the middle of nowhere. Democracy became absent.

The Muslim Brotherhood needs to be criticized for not showing any reaction when their leader, Khairat Al Shatter, was barred from the presidential candidacy. That was like a green light for the judiciary to follow with other serious decisions to come in the future. In my analysis, the military was testing the opposition. The only remaining post opened for election was the presidency. The military prepared and invested most of their resources for the presidential election. They nominated Ahmad Shafiq, who lost against the Muslim Brotherhood candidate Morsi. The military came under international pressure to accept the election of Morsi. However, two days before Morsi took office, the military came up with decisions to deny the new incoming president much of his executive powers. Morsi started with no parliament. The army, the police, and intelligence were working against him. The economy was in bad shape, and he had no constitution.

His first move was to bring back the parliament. Then, he canceled the decisions made by the judiciary earlier. The military made a mistake through the issue of security in Sinai in which Morsi removed the head of the military council, Mr. Tantawi. Morsi removed the head of military intelligence, Mr. Murad Muafi.

These moves gave Morsi political capital to spend. Morsi, the newly elected president, made two important decisions: a constitution-making committee and decreeing immunity on presidential decisions until the process of making a constitution was completed. It was supposed to take one and a half months. The opposition liberals immediately reacted by accusing Morsi as the "new Mubarak" or a new Pharaoh. It was a very harsh criticism. Everyone knew that the country was going nowhere. Morsi had to make such decisions to prevent precariousness.

Morsi made offers to various political forces but they were not appreciated. The liberals and secularists, like Mohammad Al Baradhi, rejected the offer even though the entire cabinet of the government did not include more than 40 percent of the Muslim Brotherhood. Therefore, Morsi was alone and powerless.

It is important to understand the recent history of Egyptian society. The Muslim Brotherhood has been on the scene for more than 80 years, which accounts for deep social experience. Salafists emerged mostly in the late 1980s and became an important political party. It was a movement encouraged and cared for by Mr. Omar Suleiman, the second ranking man in the Mubarak regime, who wanted to split the Islamist camp. He wanted to undermine the Muslim Brotherhood camp. He was successful to some extent. As can be seen, the Muslim Brotherhood still holds the power base of society. Other segments are secularist, Westernized, Muslim political parties. There are also liberals who call themselves the most fanatical supporters of the military coup. In addition, there are nationalists or Nasserists. This is the Egyptian political map. If you look at the representation in parliament, about 70 to 80 percent were Islamists, and the remaining are from the rest. That shows what Egyptian society is and how long the coup could continue.

Right now, we are at a political deadlock. The leader of the coup, General Sisi, is planning to run for presidency. By the way, opposition leaders, secularists, and nationalists, under the leadership of Amr Moussa and Hamdien Sabahi, declared that Sisi should run for president. The dilemma is this: if Sisi could not run for president, he could not save himself and the tutelage. If Sisi does not let Morsi out and show a new political map, he cannot save Egypt.

After the coup, the military made an approach to the Anti-Coup Coalition, which includes some Islamists, nationalists, and liberals. The coalition demands Morsi to be free, setting a date for election and abolishing the new constitution committee. There is no need to make a new constitution. The cost is high. Thousands of people have been killed and 15,000 people are in prison. The world is not showing much interest. The UN is not showing interest either, as if Egypt is a company.

If you remember, on July 3, when Sisi declared the coup, in the background there were Al Azhar Leader, Salafists, Coptic leaders and others. The scene was becoming dismantled. Al Azhar l leader, leader, could not go to the university. Salafists were fragmented. As for the Coptic leader, he risked the future of the entire Christian church in Egypt. This was the seen backdrop of the coup. The unseen backdrop of the coup was Saudi Arabia and the Emirates, who gave money to the coup, and a Western "green light" by not calling the coup a "coup." Now, Saudi Arabia is asking about the fate of $3 billion that cannot be tracked down.

The only solution, again, is the release of Morsi, and setting a date for elections. Egypt is not a small country with a population of 90 million people. You can not manage this population by Marshal Rule by imposing a curfew on 90 million. The economy is getting worse. International pressure is not available now for such a political map.

Turkey was a unique country where it called a coup a coup. Turkey helped Egypt very much. We gave $2 billion, which is now gone, and technical help. We had four military coups in Turkey in the past. Almost all of them were very painful. In the 1980 coup in Turkey, half a million people were imprisoned. About 200 people were hanged in one month after the coup. Many people were tortured. Millions lost their jobs, and tens of thousands left Turkey. To start any political life in Turkey, it takes four years to start an election with a very heavy military and judicial tutelage system. We do know what a military coup means. That is why Turkey's reaction was very harsh. It took some 25 five years since 1980 to move on. If you go back to

the 1950s, with the first multi-party system, the 1960 coup took place. It took literally 50 years to move on. It was only in 2010 there we were able to change the constitution. It was then that the Article that protected “coup makers” was abolished. The military made articles in the constitution to provide them with legal immunization from the judiciary. Even if you do not have the historical background, for the sake of Human Rights, ethics, and principles, an international actor should talk about coup in the way it deserves.

(Iyas Salim, Ph.D. Candidate,
Graduate School of Global Studies)

Special Seminar

Date: March 25, 2013 13:30–16:30
Venue: GRM Common Room, Shikokan Building, Karasuma Campus
Lecturers: Prof. Webby Kalikiti and Prof. Ackim Zulu (University of Zambia)
Title: "The Historical Geography and Energy Infrastructure of Zambia"
"About the University of Zambia"

The Global Resource Management (GRM) Program invited two professors from the University of Zambia (UNZA), Professor Webby Kalikiti and Professor Ackim Zulu. Professor Kalikiti is a historian and Professor Zulu is an electrical engineer. The title of their lecture was "The Historical Geography and Energy Infrastructure of Zambia." Doshisha University signed the Memorandum of Understandings (MOU) with UNZA, and it was completed in 2013. The relationship between the University of Zambia and Doshisha University will be more active and productive as ideas are exchanged in the near future. Thus, this lecture provided good opportunities for each side to learn more about the other. After this lecture three students from the GRM Program, including GRM candidates, visited UNZA in August 2013. The relationship between the GRM program and UNZA will grow stronger.

Zambia is well known as one of the largest copper producers in the world. Given the growth of the mining industry, as well as the population and the economy, electricity consumption is increasing every year in Zambia. Thus, it is a challenge to supply enough electricity to meet the growing demand. (However, firewood, especially charcoal—used mainly for cooking—is still the most-consumed energy source in Zambia). Additionally, large amounts of petroleum are consumed in Zambia, especially in the transport sector. Zambia is a landlocked country and does not have petroleum fuel resources, so it imports petroleum. Thus, there is a 1,700-km pipeline called the TAZAMA pipeline running from Dar-es-Salaam, Tanzania, to Ndora, Zambia. Its capacity is about 100–110 m^3 per hour (2,400 m^3 per day).

Zambia's electric-generation capacity in 2008 was 1,860MW. About 98% of the capacity is covered by hydroelectric power plants. The main consumer of electricity is industry, especially the mining industry, and its percentage is more than 60%. Zambia is located 1000–1300 meters above sea level. The average precipitation per year is 500–1500 mm, and southern Zambia receives more rainfall than the north. The dry season is from May to September, and the rainy season is from October to April. The supply of electricity decreases dramatically during droughts, because the power generators depend on hydraulic power. Therefore, it is an urgent challenge to introduce other types of power sources in Zambia, such as solar and wind power.

In addition to the lecture about energy sector, we learned about the University of Zambia. UNZA was established in 1965 and is the largest university in Zambia. More than 7,000 students are enrolled. When UNZA was established, there were only three departments: Humanities and Social Science, Education, and Natural Science. The largest department is Education. Today there are nine departments: UNZA has since added Medicine, Engineering, Mines, Agricultural Science, Veterinary Medicine, and Law. UNZA now faces some challenges: it must secure sufficient funding, and it must compete with numerous private universities in Zambia to attract the best students.

Students were able to learn about the energy sector and UNZA through the lecture by Professor Kalikiti and Professor Zulu. The energy issue, especially the electricity shortage, is an intriguing topic in Zambian affairs. The GRM program should deal with this issue and find a solution for the demand and supply of electricity in Zambia from the perspective of renewable energy by working in cooperation with the Natural Science and Social Science Departments.

(Marie Taketani, Doctoral Student, Graduate School of Global Studies)

Global Leadership Forum 1

Date: June 8, 2013 16:00–17:30
Venue: Divinity Hall Chapel, Imadegawa Campus
Lecturer: Mr. Wadah Aref Khanfar (former Director General of Al Jazeera TV Network)

[Summary of Lecture]

One of the causes of difficulty in managing the transformation and transition process in the Middle East is the lack of legitimacy of the nation-state concept. The process of state-building initiated by the French and British during the colonial era avoided the reality of nations in building the nation-state, which in Mr. Wadah's opinion was illogical and irrational. The Middle East consists of the Iranian nation, the Turkish nation, and the Arab nation. In the process of nation-state building, the Iranian nation became one state, and the Turkish nation became one state, while the Arab nation separated into 22 states. The new type of nationalism faces numerous challenges in the context of identity among these Arab states.

Before the Arab Spring, the polarization in every Arab state was easy to define: the government was on one side and the opposition on the other. But nowadays, there are a lot of interest groups in between, those who intend to influence the process of democracy. We have to realize that no country in the world started out with democracy.

One solution to the problems of legitimacy within Arab countries is by rebuilding the state. Some states should be divided, and others need to be merged. For instance, Iraq could be divided into three new states, consisting of Sunni Iraq, Shia Iraq, and Kurdish Iraq. But such an idea seems unrealistic, because of Western interests in the region. To some extent, Western countries tend to keep the conflict going in order to maintain their presence in the region.

The transformation to democracy is the moment in history when political maturity became part of the public agenda. People have many complaints about politics, but they have not been able to communicate it. With the rise of mass utilization of social networks and media, they have an opportunity to speak out.

The transition, which started in Tunisia and went through Libya and Yemen, are all part of Arab Springs, but each transition has its own context, simply because the transformation itself is a long process. It is not just about structural or systemic political change; it also includes social, cultural, economic, and even philosophical transformation.

To clarify our understanding of the process in the region, we should distinguish between African and Asian countries. For the most part, the transformation in the African countries already went through the third wave of democratization, well before the current Arab Spring. The focus now should be the transformation in Asia, where many Arab countries are located.

After the lecture, there was a lively debate between Mr. Wadah and Mr. Ishiai Tsutomo (a journalist and the foreign news editor of Asahi Shimbun). The main points of discussion were as follows:

- The future of democratization in the region, following the current situation in some hot-spot countries and the relations among countries in "conflict," like Syria, Turkey, Egypt, and Israel.

- The impact of massive media coverage of the Arab Spring on coverage of the Palestinian issue.

- The role of Al Jazeera as an independent media outlet in promoting democratization, including how this outlet (which consists of more than 4,000 people from 55 nationalities who have different religions and ideologies) maintains its neutrality and provides balanced news.

- Some personal concerns, including the reason for Mr. Wadah's resignation from Al Jazeera and the clarification of the Wikileaks reports about his relations with the United States and the pressure to change the coverage about the Iraq war.

(Ishaq Rahman, Doctoral Student, Graduate School of Global Studies / Lecturer, Department of International Relations, Hasanuddin University)

Global Leadership Forum 2

Date: September 26, 2013 13:00–14:30
Venue: Learning Studio, Shikokan Building, Karasuma Campus
Lecturer: Ms. Sadako Ogata (Special Advisor to the President of JICA)

This lecture was held as a dialogue between graduate school students and Ms. Ogata, who has been working on the front line of international aid and development as a head of the UN High Commissioner for Refugees and special advisor to the president of Japan International Cooperation Agency(JICA). Students who participated were Afghan students from the Project for the Promotion and Enhancement of the Afgahn Capacity for Effective Development:PEACE, Japanese Grant Aid for Human Resource Development Scholarship:JDS students from Kyrgyzstan, and students from Japan, Palestine, Mexico, Indonesia, and the United States.

In the first part of the lecture, participants discussed development issues in Afghanistan and other developing countries. In the last part, the main issue was Ms. Ogata's thoughts on the many difficult problems she tackled in the field of human security and development.

The following is a summary of the lecture.

■ "Self-Development"

At the beginning, Ms. Ogata talked about the importance of countries developing their societies by themselves. Afghan students asked Ms. Ogata about problems that Afghanistan has been facing as a post-conflict society and the prospect of JICA schemes to solve it, such as the possible role of JICA in Afghanistan after the withdrawal of the ISAF and how JICA could deal with corruption in Afghanistan or the lack of energy management capacity there. Responding to these questions, Ms. Ogata stressed the importance of self-development. What JICA does for Afghanistan is to help the Afghan government and Afghan people to reconstruct their society by themselves, not for JICA to do it instead. The PEACE project is also part of the human capacity development launched by JICA for Afghan society. Ms. Ogata also answered a question about the relationship with the private sector. In a way, giving direct assistance to the private sector would be efficient, but development assistance should help show local people how to build schools rather than providing schools. JICA's role lies in between the private sector and the public sector.

■ Sensitivity to the local culture and history

Ms. Ogata's second theme was that aid agencies must be sensitive to the culture and history of recipient countries. In Indonesia, JICA assisted in the reform of the national police and subsequently a women's police station was set up following a suggestion from the Indonesian government. The background of this project was women's social advancement in society, and it has been creating security for local women. Ms. Ogata emphasized that technical assistance should be locally focused and locally effective. She also mentioned that disaster management and peace-building are heavily influenced by the culture of recipient countries. Every country has their own way of doing things; therefore, what is effective in one country may not work in another. Moreover, she discussed development approaches such as bottom-up or top-down. While there are many critical assessments of the top-down approach, it is effective in certain countries. Aid agencies should employ approaches case by case. There is no one recipe for all development assistance or all countries.

■ Careers in international society

She answered questions about strategies to be implemented in international agencies and her motivation for working in her field. She recommended that students not attempt to do everything but instead cultivate their own expertise in a specific area to help others and work alongside others. She also talked about her background as a historian researching the political history between Asian countries and the United States. Before she got involved in current events, in her research on World War II

and the postwar recovery, she became curious why Japan decided to engage with the United States. This core question would be a driving force in her life.

■ Civil war and the security of people

As UN High Commissioner for Refugees, Ms. Ogata handled the crisis of refugees and Internally Displaced Persons (IDP) in the former Yugoslavia and many other countries. She mentioned that the major function of UNHCR is to protect people. It is not only refugees who have fled their countries who need protection; sometimes the UN must provide security for people from their own government. The security of people is a new doctrine for Ms. Ogata and JICA. Regarding the current situation in Syria, she stated that the UN and Mr. Brahimi must try to protect people by containing the chemical weapons and by creating negotiation opportunities. Moreover, she said that it is not too late to "do anything" to solve the problems. Finally, she pointed out that Syria was one country that helped many Iraqi and Palestinian refugees.

(Mayuko Hagari, Master's Student,
Graduate School of Global Studies)

Global Leadership Forum 3

Date: November 26, 2013 15:00–16:30
Venue: Learning Studio, Shikokan Building, Imadegawa Campus
Lecturer: Mr. Atsutoshi Nishida (Director, Chairman of the Board, Toshiba Corporation)
Title: "The Globalization Process of Leading Companies"

The lecture consisted of three parts:

-What globalization imposes on global companies

-Important factors to bear in mind

-Global leadership competencies

First, global companies have to struggle with the triangle dilemma among sustainable development, resource management, and environmental management. In Japan, the current government has been seeking to recover from the crisis with the Three Arrows policy after the failure of the 12-Growth Strategy. In other words, there are questions about whether the government can successfully carry out its policy.

Second, based on this globalizing situation, the global companies should bear the following factors in mind (especially factors 1 and 2):

1. Continuous innovation: to create new "value" for the market through process innovation in manufacturing and value innovation such as work-life balance.

2. Pursuit of efficiency: to continuously enhance productivity, especially in the service industry, finding mistakes, areas to be improved, and waste to be reduced.

3. Mitigation of risks: to deal with economic crisis and natural disasters.

4. "Corporate" management of various business: to deal with intensifying competition and the velocity of globalization

5. CSR (Corporate Social Responsibility) for the survival of humanity: environmental management

Third, when it comes to global leadership competencies, three capabilities were pointed out:

1. Capability for judgment: to grasp the current situation, to analyze what to improve, and to make clear what to do.

2. Decision-making capability: to decide what to do.

3. Execution capability: to accomplish the objectives.

The recent environmental crisis has been illuminated by issues such as climate change, which embodies global interdependencies in which the actions of one country have significant outcomes for developments elsewhere (Dominelli 2012: 87).

As is widely recognized, such a crisis stems from industrialization and urbanization. Industrialization has produced pressures for centralization and the development of urban environments and built infrastructures that are driven by the creation of opportunities for business to make profits, and by the movement of people following the resulting employment prospects (Dominelli 2012: 42).

As advanced countries such as the United States, Japan, and the member states of the EU are said to be responsible for this crisis as "polluters," global companies owe the world a debt for the footprints they leave through their globalization process. It is obvious that global companies are profit-oriented if their only stakeholders are shareholders. However, they exist in society, and society consists of communities. That means that global companies cannot survive without allowing the relevant communities to participate in discussion and decision-making.

Inevitably, we need a leader as the driving force to accomplish the world's mission as stated above. The leader of global companies must make clear how to create a participative system for judgment, decision-making, and execution. The time has come for "co-

production" (Pestoff and Brandsen 2008) among multistakeholders.

[References]

Dominelli, L. (2012), *Green Social Work: From Environmental Crises to Environmental Justice*, Polity Press.

Pestoff, V., and T. Brandsen (2008), *Co-production, the Third Sector and the Delivery of Public Services*, Routledge.

(Yujiro Minami, Master's Student,
Graduate School of Social Studies)

International Conference
"Transforming Conflict and Building Cohesion through Identity"

Date: July 5-6, 2013
Venue: SK112, Shikokan Building, Karasuma Campus

On July 5-6, 2013, scholars and practitioners from over eight countries came together at Doshisha University, Kyoto to explore the current theories and practices for transforming conflict and building cohesion by cultivating an understanding of identity dynamics.

The conference was hosted by the Graduate School of Global Studies (GS) and the school's Global Resource Management (GRM) Program. Several members of the Organization for Intra-Cultural Development were invited. The conference was broken into four sessions.

In Session One, five speakers covered the psychological, anthropological and epistemological theories and practices that define their disciplines' approach to understanding identity and conflict. The session was chaired by Prof. Nakanishi, an expert on conflict resolution in the Middle East. It became evident in this session that there was a need for a more holistic approach towards understanding the mechanisms of identity and change. Only this holistic approach, taking in multiple identities and broadening ideas of cultural identity, can be of practical help in increasing the effectiveness of real world projects.

Chaired by the Former Special Representative for the Secretary General, UN Mission Timor Leste, Prof. Hasegawa, Session Two attempted to compare and contrast different approaches to utilizing identities, or an understanding of identities, in directly promoting cohesion and transforming conflict. Prof. Hasegawa's closing remarks clearly highlighted the importance of interdisciplinary cooperation in both formulating theory and practicing effective methodological approaches.

The regional contexts that define the nature of conflict transformation / cohesion needs are broad and varied. In Session Three, chaired by Pierre Sané, Former Secretary General of Amnesty International and Assistant Secretary General, UNESCO, the speakers detailed case studies from Israel-Palestine; Zambia and West Africa; and former Yugoslavia and the Caucasus. Despite the seemingly intractable problems related to each region, the presentations demonstrated how understanding identity as the root cause of conflict could also potentially lead to exploring how those same dynamics may be utilized in the building of solutions.

Session Four showcased the work that the GS / GRM students had produced over the duration of the semester. Six students were divided into two teams and their detailed reflections are as follows:

【Team: Sri Lanka】

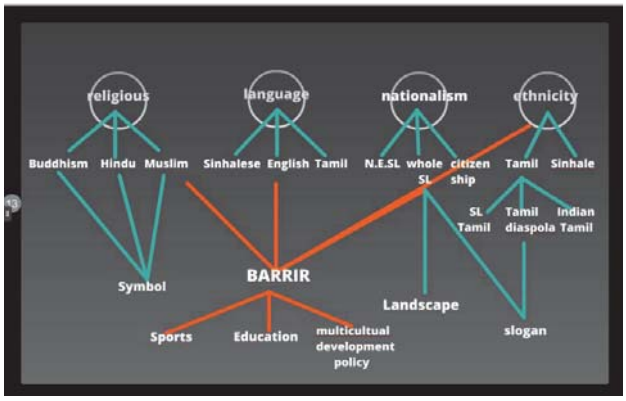
Guneshwor Ojha , Nazgul Emilbaeva,

and Aya Kainoh

1. Research process

First, we decided to focus on the post-conflict situation in Sri-Lanka. We found the post-conflict situation was still complicated as peace was not an outcome of negotiations between the government and the rebels. This called for research into the socio-economic and political history of Sri Lanka. We started with the ancient history of Sri Lanka to assess the current situation marked by fragile peace.

We found that until the colonial period, Sri Lankan society enjoyed peace and harmony in its modern history. The problem started with the British policy of divide and rule, and the discriminatory policies of subsequent governments. We did a "mapping" of the Sri Lankan conflict to identify key concepts and barriers among the major ethnic communities involved in the conflict: Sinhalese (Buddhist) and Tamil (Hindu). The results are featured below. We also uncovered connections to unite the diverse ethnic communities of Sri Lanka.



As part of this research, we reached out to Sri Lankan nationals who provided us with much needed input. Thus, we were able to explore the identity issues among the dominant ethnic communities, the practice of "othering," and the different factors behind the violent conflict. We combined our individual research to develop a clear picture of the Sri Lankan conflict. We used several symbols and pictures to make the presentation effective and developed intervention measures in addition to the media campaign aimed at promoting lasting peace in Sri Lanka.

2. "Transforming Conflict and Building Cohesion through Identity"

The International Conference "Transforming Conflict and Building Cohesion through Identity" was organized by the Global Recourse Management Office of the Graduate School of Global Studies, Doshisha University, Kyoto, and was held July 5-6, 2013 in Japan.

First, we would like to note the high level of organization and professionalism with which this conference was conducted. Professors and Doctors of Sciences from different universities around the world were invited to take a part in this event, and lecture and present on the aforementioned theme. This conference was the first of its kind for all of us. In spite of the warm and friendly atmosphere of the conference, we felt a bit nervous and emotional. The hard part of the presentation was answering questions from speakers and participants. Undoubtedly, it was a very significant and fruitful event throughout which experts and students shared their views on solving the issues of identity, which play an important role in all of humanity. Moreover, this opportunity allowed students to expand their horizons and become acquainted with interesting people.

3. Outcome of the presentation at the International Conference Student Session – 2013

Our presentation on Sri Lanka elicited several comments from scholars. While they appreciated the team's well-coordinated presentation featuring Sri Lanka as a post-conflict country struggling to achieve a lasting peace, the scholars also drew our attention to different aspects of the research procedures. They stressed that academic research needs to include diverse research sources in order to authenticate its findings. For example, they cited that rather than relying only on the BBC for media research, we should have referred to Al Jazeera as well. The scholars identified that the students were seriously lacking in empirical knowledge of this project and encouraged us to do field work while undertaking such research. They also stated that identity can serve both as the source of conflict as well as an effective peace-building tool. The experts mentioned that justice is another key factor in any conflict situation, in addition to identity. By observing the scholars present during the first day, we became acquainted with academic presentation skills and applied those to our presentation on the second day. We appreciate that the program boosted our confidence and aptitude for research activities. The project has immensely improved our analytical skills, as well as our ability to interact with people.

【Team: Darfur】

Megumi Inaka, Kaho Suzuki,

and Atsushi Takabatake

For this year's international conference, we gave a presentation on the Darfur conflict, and provided our own observations to construct possible solutions for mitigating genocide through identity. Throughout the semester, we researched and prepared for the conference during weekly study sessions in which we discussed the information we had gathered, including newspapers, magazine articles, dissertations, and much more. In order to understand the current conflict situation and to illustrate the relationships among different key ethnic groups, we created a mind map, which we used to brainstorm ideas and develop concepts and ideas that could be utilized to ease the tension in Darfur. From the research we had undertaken, we noticed that the ongoing conflict in Darfur was not just a fight between two ethnic groups (Black Africans and Arab Africans), but was primarily fueled by the Khartoum government. In short, the Khartoum government has been using identity as an integral tool to manipulate the inferior race and exploit their land and resources for the purpose of personal gain from the national wealth. Therefore, it was important for us to review the Darfur conflict, and to conduct more in depth research on different ethnic groups and how this correlates with the concepts and ideas, so that we could derive some symbolic interventions for resolving the conflict.

Upon reflection our overall work in this class and the feedback we received from both professors and speakers at the conference, we realized that there was significant room for improvement. Since this was our first presentation as graduate students, and we had listened to presentations given by renowned professors, we were very nervous. During our presentation, we assigned each person a designated topic to present on, and used Prezi as our visual aid to illustrate important points. In retrospect, we thought the presentation itself was well organized and went smoothly. However, concurrently, we believe the questions and feedback from the audience was the most challenging part of the conference. Most of the questions were unanticipated, and thus we were ill prepared for that part of the session. Despite that challenge, most of the audience was very supportive and provided us with positive comments and feedback. Taking that into consideration, for our future presentations, we will need to find more resources from a wide array of perspectives, and be well-prepared for any criticisms that we may receive from the audience. We learned a great deal from the entire experience, and hopefully this can be put in good use by other students who wish to take this class.

(Dr. Bruce White, Associate Professor,
The Institute for The Liberal Arts, Doshisha University, and the students of the 2013 Spring "International Conference Planning and Presentation" course)

International Workshop on Renewable Energy 2013

Date: October 2-3, 2013
Venue: Hanoi, Vietnam

The work of three Global Resource Management (GRM) Program students was presented at the 2013 International Workshop on Renewable Energy, in Hanoi, Vietnam. This workshop was an opportunity to bring together multidisciplinary experts from the academic world, industry, and government institutions to discuss the current challenges and opportunities for renewable energy in power systems. In recent years, renewable energies have become an emerging issue with regard to the energy infrastructure. Significant quantities of renewable energy in power systems require not only a great deal of technical effort, but are also of economic and political concern.

The presentations in this workshop dealt primarily with the electrical issues found in the introduction of renewable energy systems into existing power grids. Renewable energies, the most common of which are solar and wind power, are inherently variable and produce a fluctuating power output. Therefore, special consideration must be given to the variations in voltage and current, as they would decrease the power quality of the grid. The presentations showed novel methods for measuring and minimizing the effect of these variations. Strategies for efficient coupling of renewable energy systems, and protection against energy discharges, were also presented.

The GRM students presented three topics. The first presentation addressed the use of renewable energies as a power generation mean to provide quick relief support to isolated communities when they lose connection to the power grid. When fuel supply is not available, electricity may instead be generated through micro-hydraulic power, wind power, and photovoltaic solar power systems. The cost assessment of these power systems used as reference in this presentation, and developed by the Japan International Cooperation Agency (JICA), was of special interest to the audience.

The second presentation involved a roadmap for the reconstruction of Syria's energy infrastructure, which has been severely damaged by the current armed conflict. Especially in the southeast part of Syria, which is mostly deserted and where no transmission network exists, the possible installation of photovoltaic solar systems, together with solar water heating, seemed to be a promising solution for supplying electricity to refugee camps and isolated regions. Implementation of wind farms, small hydraulic turbine generators, and underground water storage systems were also discussed as part of a plan to introduce renewable energies into Syria's future energy infrastructure. Underground water storage systems, which have already been implemented in Japan, seemed to be the most appealing topic in this presentation.

The last presentation analyzed Zambia's water resources and the feasibility of installing more hydroelectric power stations. Due to its low cost and the large amount of water resources available in Zambia, hydroelectric power seemed to be a viable option. Pumped-storage systems also needed to be considered, as electricity surpluses during rainy seasons can be used to refill water reservoirs; this can then be used for farming or sanitation, as well as for increased power capacity during dry seasons. To achieve total power coverage from hydroelectricity, energy saving strategies should also be considered, such as replacing incandescent light bulbs with fluorescent or LED lighting, and older appliances with more energy efficient ones.

Group picture from IWRE 2013

(Jorge E. Lamas, Doctoral Student,
Graduate School of Science and Engineering)

International Student Session (ISET/ISS 2013) in Thailand

Dates: November 27–28, 2013
Venue: Samui Palm Beach Resort, Conference Room, Thailand

1. ISET/ISS

The ISET/ISS was cooperatively organized by Doshisha University (Japan), the University of Bologna (Italy), and Seoul National University (Korea) under the Triangle Cooperative Agreement between these three universities. The Federal Institute of Technology Lausanne (Switzerland) and King Mongkut's Institute of Technology Ladkrabang (Thailand) have also participated as organizers of the ISET/ISS since 2011.

ISET/ISS 2013 was held in Samui Island, Thailand, on November 27–28, 2013. The ISET/ISS 2013 provides the opportunity for a university student to present his or her paper in the International Student Session (ISS). There are two sessions, as shown in Tables 1 and 2:

1. International student session: 32 papers were presented. The presenters were MSc and PhD students from Doshisha University and King Mongkut's Institute of Technology Ladkrabang.

2. ISET Symposium "Unified Education of Social, Human, and Natural Science in Universities": Five papers were presented. The presenters were professors from Doshisha University, Seoul National University, King Mongkut's Institute of Technology Ladkrabang, and Hanoi University of Science and Technology.

2. Approaches for operation of ISS 2013

The ISS session was organized and operated by students in the class Global Resource Management (GRM) Organizing International Conference I. The students organized the following staff:

ISS Committee
Chair: *Tran Huu Thang*
Vice Chair: *K. Nakamura*
Secretary: *Y. Miyamoto*

Subcommittee A
Registration, Flight and Hotel Reservations
M. Kusumoto, T. Higo, Y. Motoya

Subcommittee B
Program, Proceedings
D. Tanahashi, K. Yamamoto, Y. Oshima, Y. Suzuki, Y. Tanaka

Subcommittee C
News
M. Aoki, T. Asada, Y. Imanishi, K. Takenaka

Subcommittee D
Operation
H. Shiraishi, S. Yamada

Fig.1. All participants joined the 2013 ISET/ISS

Fig. 2. The scene of the opening session

1.) ISS Committee

In general, we supported the subcommittee members. We made records of the lectures for the meeting and generated a mailing list for ISS Committee members. Finally, we shared information, including the collection of passports, the schedule, location, schedule changes, etc.

2.) Subcommittee A

We made flight and hotel reservations. We discussed travel agencies and then decided that the best travel agency was one that had a local branch office. We worked the front desk on the day of ISS.

3.) Subcommittee B

At the beginning, we determined the schedule and session program, as shown in Tables 1 and 2. Then, we collected the papers and formed the proceedings.

4.) Subcommittee C

First, we checked the GRM office to see if there were rental video cameras. We had discussed the roles on the day of the ISS and the filming points. We set up the equipment and rehearsed one day prior to the ISS.

5.) Subcommittee D

We made lists of the necessary equipment and checked the equipment available in the conference facilities in advance. We then prepared and purchased the equipment we lacked. This committee kept track of time on the day of the ISS.

Fig. 3. Checking and preparing the equipment

Fig. 4. Front desk on the day of the ISS

Fig. 5. Setup for the filming

Fig. 6. Session chair of the ISS

Fig. 7. Timekeeper for the ISS

3. Presentations at the ISS

All students in the class submitted their papers to the ISS and made presentations in English. Students in both information engineering and electrical engineering participated in the conference, which made for some nice discussions. On a few occasions, we missed statements by audience members because they were foreigners speaking with strong accents.

Fig. 8. Participants gathered for the 2013 ISET/ISS

Fig. 9. Participants gathered for the 2013 ISET/ISS

Fig. 10. Participants gathered for the 2013 ISET/ISS

4. ISET Symposium

1.) *Prof. A. Ametani*, Doshisha University
"On the Global Resource Management Program"

Our university has engaged in peace-building operations in Afghanistan. The GRM program is deeply concerned with these operations and committed to developing human resources. The aim of the Global Resource Management Program is not to produce highly specialized researchers but PhDs who can collate knowledge from various disciplines to promote sustainable development and multicultural harmony.

2.) *Prof. Y. T. Yoon*, Seoul National University
"Strengthening University Education through a Unified Curriculum of Engineering and Humanities"

The university education is similar to that of the Japanese university. The curriculum consists of major and general education courses. However, the number of requirements for specific areas is about half of that of our university.

Fig. 11. Prof. A. Ametani

Fig. 12. Prof. Y. T. Yoon

3.) *Dr. T. H. Pham*, Hanoi University of Science and Technology

"Social Education for Future Engineers in Vietnam: An Approach from Hanoi University of Science and Technology"

Dr. T. H. Thang made a presentation on behalf of Dr. T. H. Pham, who was absent. This was a very interesting presentation on social education for engineers. At Hanoi University, the required coursework for engineers includes social science classes in management, ethics, and politics.

4.) *Dr. P. Yutthagowith*, King Mongkut's Institute of Technology

"Basic Electrical Engineering for Social/Human Science Students"

The target audience for this lecture was non-electrical engineering students. In his lecture, Dr. Yutthagowith presented basic principles of electricity and gave the students a better understanding of electricity and its applications.

5.) *Prof. K. Yamabuki*, Wakayama National College of Technology

"Infrastructure Laboratory Work for Social/ Human Science Students"

This presentation introduced the outline of Infrastructure Laboratory Work (ILW), a subject of the GRM program. It is designed for non-electrical engineering students to acquire fundamental knowledge and techniques of electrical engineering through practical experiments.

Fig.13. Dr. T. H. Thang

Fig. 14. Dr. P. Yutthagowith

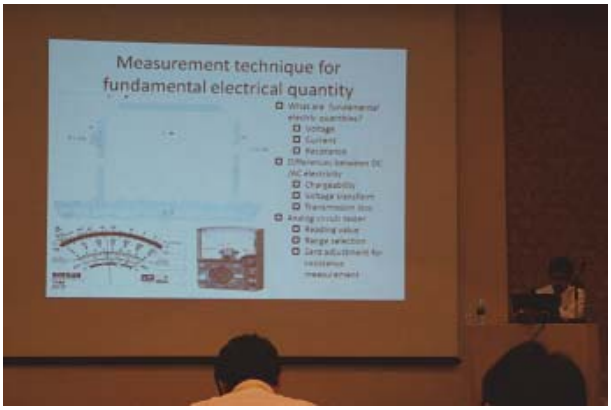


Fig. 15. Prof. K. Yamabuki.

5. Concluding Remarks

It was a very pleasant and exciting experience for all the students who participated in and facilitated the ISET/ISS 2013 in Samui. We never had this kind of experience before. We hope to organize an international conference or symposium on our own in the future.

Finally, we would like to thank Prof. A. Ametani, who teaches the class Organizing International Conferences and arranged this opportunity.

(Tran Huu Thang, Ph.D. Candidate, Graduate School of Science and Engineering, Keisuke Nakamura, and Yoshiko Miyamoto, Master's students, Graduate School of Science and Engineering)

Table 1 ISET/ISS 2013 schedule

ISET/ISS 2013 Symposium: "Unified Education of Social, Human, and Natural Science in Universities," Samui Program

Wed. November 27

A. International Student Session (ISS)

ISS-I: Transient Analysis / Chair: King Mongkut's Institute ·····8:50–10:40

Opening talk: Prof. A. Ametani

ISS-01 to ISS-10 10 student presentations

Coffee break 10:40–11:00

ISS-II: System Dynamics in Infrastructures / Chair: Seoul National Univ. ····· 11:00–12:40

ISS-11 to ISS-20 10 student presentations

Lunch 12:40–14:00

ISS-III: Information Technologies / Chair: Diah Permata ····· 14:00–14:50

ISS-21 to ISS-25 5 student presentations

ISS-IV: Infrastructures Related Subject I / Chair: Y. Ikeda ····· 14:50–15:20

ISS-26 to ISS-27 2 student presentations

Coffee break 15:20–15:50

ISS-V: Infrastructures Related Subject II / Chair: H. T. Tran ····· 15:50–16:40

ISS-28 to ISS-32 5 student presentations

Welcome banquet 18:00–20:00

Thurs. November 28

B. Symposium "Unified Education of Social, Human, and Natural Science in Universities"

Session I / Chair: Prof. Y. Baba, Doshisha University ·····9:00–10:30

ISET-1 to ISET-3 3 presentations

Coffee break 10:30–11:00

Session II / Chair: Prof. Y. T. Yoon, Seoul National University ····· 11:00–12:00

ISET-4 to ISET-5 2 presentations

Lunch 12:30–13:45

Closing 13:45–14:00

Table 2　Session program

A. International Student Session (ISS) ····· Wed. November 27, 2013

ISS-I: Transient Analysis ····· 9:00–10:40

ISS-01　Application of the Rational Function-Based CIP Method to Analyzing Lightning Electromagnetic Fields
Y. Suzuki, MSc, Doshisha University, Kyoto, Japan

ISS-02 FDTD Analysis of LEMPs Considering Ground Geometry and Grounded Structure
M. Aoki, MSc, Doshisha University, Kyoto, Japan

ISS-03　Computation of Lightning Electromagnetic Pulses with the TLM Method in the 2D Cylindrical Coordinate System
Y. Tanaka, MSc, Doshisha University, Kyoto, Japan

ISS-04　Simulation of Lightning Electromagnetic Pulses Using the Constrained Interpolation Profile Method
K. Kajita, MSc, Doshisha University, Kyoto, Japan

ISS-05　Application of Non-Uniform Grids to EM Field Analysis with the TLM Method
S. Sawaki, MSc, Doshisha University, Kyoto, Japan

ISS-06　Representation of Vertical Cylinder by Cubic Cell in FDTD for Modeling of Wind Turbine Tower
Y.Ikeda, PhD, Doshisha University, Kyoto, Japan

ISS-07　FDTD Study of Partial-Discharge EM Pulses in a GIS
D. Tanahashi, MSc, Doshisha University, Kyoto, Japan

ISS-08 The Frequency Characteristic of Attenuation on a Vertical Two-Conductor Overhead Line
Y. Miyamoto, M. Sc., Doshisha University, Kyoto, Japan

ISS-09 A Study on Experiments of Lightning Surges in a Building by Using FDTD Analyses
T. Asada, MSc, Doshisha University, Kyoto, Japan

ISS-10 FDTD Electric Field Simulation of Surge Arresters in Substations
R. Okuda, MSc, Doshisha University, Kyoto, Japan

ISS-II: System Dynamics in Infrastructures ····· 11:00–12:40

ISS-11 An Analytical Investigation of a Phase Controlled Switch using a Voltage Limiting Device
K. Yamamoto, MSc, Doshisha University, Kyoto, Japan

ISS-12 Effect of L-Type Duct on Surge Voltage of PCS for PV Generation
T. Higo, MSc, Doshisha University, Kyoto, Japan

ISS-13　A Frequency-Dependent Equivalent Circuit of an Impedance Bond of a Railway Signaling System
Y. Imanishi, MSc, Doshisha University, Kyoto, Japan

ISS-14　A Basic Study of an Impedance Estimation of Lithium-Ion Battery by a Numerical Frequency Transform Method
S. Yamada, MSc, Doshisha University, Kyoto, Japan

ISS-15 Equivalent Soil Medium for a Scaled Grounding Test
S. Murase, MSc, Doshisha University, Kyoto, Japan

ISS-16 A Synchronization Method of a PLC System Based on OFDM
S. Takemura, MSc, Doshisha University, Kyoto, Japan

ISS-17 A Ground Fault Analysis of a Photovoltaic Generation System

A. Namba, MSc, Doshisha University, Kyoto, Japan

ISS-18 Lightning Surge Over-Voltages due to Multiphase Back Flashovers

Y. Yamamoto, MSc, Doshisha University, Kyoto, Japan

ISS-19 Transient Characteristics in a Vertical Grounding Electrode

K. Nakamura, MSc, Doshisha University, Kyoto, Japan

ISS-20 A Study on Grounding Characteristics of a Wind Turbine System

N. Yoshikawa, MSc, Doshisha University, Kyoto, Japan

ISS-III: Information Technologies ····· 14:00–14:50

ISS-21 Effect of Window Luminance on Office Worker's Preferred Illuminance

M. Kusumoto, MSc, Doshisha University, Kyoto, Japan

ISS-22 Systematic Evaluation of Local-Lag Control Function in Remote Ensemble Support System

Y. Oshima, MSc, Doshisha University, Kyoto, Japan

ISS-23 Power-Saving Control of the Wireless Sensor Node in the Intelligent Lighting System

Y. Motoya, MSc, Doshisha University, Kyoto, Japan

ISS-24 Experimental Evaluation of Minimum Classification Error-Based Multiclass Support Vector Machine

K. Takenaka, MSc, Doshisha University, Kyoto, Japan

ISS-25 Experimental Re-evaluation of Minimum Classification Error Training using Validation Data

H. Shiraishi, MSc, Doshisha University, Kyoto, Japan

ISS-IV: Infrastructures Related Subject I ····· 14:50–15:20

ISS-26 Modeling of Corona Discharge for FDTD Simulations of Lightning Surges

T. H. Thang, PhD, Doshisha University, Kyoto, Japan

ISS-27 A Modeling of an Impedance between Electrodes in a Wood using a Numerical Electromagnetic Analysis

D. Permata, PhD, Doshisha University, Kyoto, Japan

ISS-IV: Infrastructures Related Subject II ····· 15:50–17:10

ISS-28 Design and Construction of a High Voltage Measuring System Based on Saline Solution

B. Phoaphan, MSc, King Mongkut's Institute of Tech. Ladkrabang Bangkok, Thailand

ISS-29 Design and Construction of a Long Duration Impulse Current Generator

C. Prasertsang, MSc, King Mongkut's Institute of Tech. Ladkrabang Bangkok, Thailand

ISS-30 Determination of Optimum Rating of an Ozone Generator for a Room in a Hospital

M. Chidchanok, MSc, King Mongkut's Institute of Tech. Ladkrabang Bangkok, Thailand

ISS-31 Steep Front Voltage Generation for Puncture Test in Air of Insulators

N. Trirattanapirak, MSc, King Mongkut's Institute of Tech. Ladkrabang Bangkok, Thailand

ISS-32 A Rogowski Coil with an Active Integrator for Measurement of Long Duration Impulse Currents

B. Leelachariyakul, MSc, King Mongkut's Institute of Tech. Ladkrabang Bangkok, Thailand

B. ISET/ISS 2013 Symposium ····· Thurs. November 28, 2013

Unified Education of Social, Human, and Natural Science in Universities

Session I ····· 9:00–10:30

ISET-1 On the Global Resource Management Program

Prof. A. Ametani, Doshisha University, Kyoto, Japan

ISET-2 Strengthening University Education through Unified Curriculum of Engineering and Humanities

Prof. J. K. Park and Prof. Y. T. Yoon, Seoul National University, Seoul, Korea

ISET-3 Social Education for Future Engineers in Vietnam, an Approach from Hanoi University of Science and Technology

Dr. T. H. Pham, Hanoi University of Science and Technology, Hanoi, Vietnam

Session II ····· 11:00–12:30

ISET-4 Basic Electrical Engineering for Social/Human Science Students

Dr. P. Yutthagowith, King Mongkut's Institute of Tech. Ladkrabang, Bangkok, Thailand

ISET-5 Infrastructure Laboratory Work for Social/Human Science Students

Prof. Yamabuki, Wakayama National College of Technology, Wakayama, Japan

International Workshop
"Assessing Reconciliation: Actors, Risks, and Assets"

Dates: December 16–17, 2013
Venue: SK110, Shikokan building, Karasuma Campus

The international workshop examined the practice of reconciliation in its full complexity and geographical dispersion. Participants attempted to find answers to questions including the following:

Who needs to reconcile and why?

How can they do so?

Who can positively contribute to this process?

What are the potential obstacles?

The presentations and discussions highlighted the global nature of the workshop, which covered a number of regions including the Middle East, Africa, and Southeast Asia.

The event attracted a diverse spectrum of academics and practitioners from around the world. The guests represented a variety of international organizations and institutions, including the Central Asian Studies Center (casc.kz), International Institute for Peace Studies, Osaka University, Kimse Yok Mu (a Turkish nongovernmental organization), and Cheikh Anta Diop University. The presenters and guests came from such countries as Japan, Kazakhstan, the United States, Thailand, Mali, Turkey, and others, ensuring the international character of the workshop.

Professor Masanori Naito, director general and dean of the GRM program at Doshisha University, opened the first day of the international workshop. His speech reminded us of the need for reconciliation apparent in a number of states and regions and of the troubles associated with ignoring this need.

Following the opening remarks, Hiroshi Matsuhisa, honorary professor emeritus of Kyoto University, gave a keynote speech in which he addressed a conventionally neglected aspect of reconciliation: reconciliation between developed and developing countries. His speech emphasized that discussions on reconciliation should not be limited to postconflict societies and states but must involve a broader, global perspective.

After the opening remarks and the keynote speech, graduate students of the GRM program took the floor and led the workshop through both days. The two days of the workshop covered two separate, though interrelated, themes linked to reconciliation. During the first day, the participants and guests discussed the problem of risks in practices of reconciliation.

The first presenter, Naomi Nishi, a PhD student in the GRM program at Doshisha University, talked about the distribution of political risks in Thailand and their effects on reconciliation between Muslims and Buddhists in the country. The second presenter, Marie Taketani, a PhD student in the GRM program, outlined the obstacles to reconciliation in Mali.

The second theme covered during the workshop centered on the question of actors in reconciliation processes. Nikolay Shevchenko, a PhD student in the GRM program, opened the second day with his presentation on the potential contribution and limitations of international actors in assisting postconflict Libya in its attempt to address past injustices and reconcile former enemies. Following his presentation, Toshie Inui, a PhD student in the same program, spoke about the problem of water distribution in Rwanda and its effects on reconciliation between different regions in the country. The last presenter, PhD student Moriyama Takuya, concluded the second day of presentations with

his speech on the role of civil society in reconciling secular and religious paths to development in Turkey.

A majority of the presenters based their papers and presentations on fieldwork they conducted personally during their study in the GRM program.

During both days, presenters and guests discussed the problems, issues, and controversies touched on by the five presentations. The discussions covered various aspects of reconciliation, including humanitarian interventions, regime change, foreign aid, organized crime, drug trafficking, charity, religion, education, development, and many others, all in relation to the overarching topic of the workshop.

(Nikolay Shevchenko, Doctoral student,
Graduate School of Global Studies)

Onsite educational field trip to Miyako Island

Date: March 10-13, 2013
Venue: Miyako Island, Okinawa Prefecture

The program of Global Resource Management is available to the graduate school students in the social sciences and science and engineering. The program offers students a range of new learning opportunities in diverse fields, which they can go on to utilize as global leaders in the context of developing and emerging countries.

For the first onsite educational field trip, we visited Miyakojima, in the Okinawa prefecture, from March 10 to 13, 2013. This island has a smooth terrain, composed of elevated coral reef (Ryukyuan limestone). Miyako Island is subject to drought and is frequently struck by typhoons. Therefore, it has suffered in the past from a lack of water resources. Miyako now has unique irrigation systems, which use the island's geographic characteristics effectively. Moreover, Miyako City is one of 41 cities running the "Next Generation Energy Park" project, established by the Minister of Economy, Trade, and Industry. The project promotes understanding of the new energy policy and an examination of renewable and sustainable resources, such as solar-energy systems and wind-energy systems in collaboration with existing systems, such as thermo-powered energy.

We visited four infrastructure facilities during the field trip to Miyakojima, including one of the Next Generation Energy Parks. We attended lectures given by professionals at each of these facilities, to deepen our understanding of the energy systems.

This report describes each of the facilities that we visited, from both the social science and the engineering perspectives. We then outline the schedule of the field visit to the facilities. As this is a group work, we have divided each of the four sections between the social science students, allowing each of them the chance to add their own perspectives in places. The student from science and engineering has also added their own related perspectives. One social science student has written the introduction and conclusion, and has edited the paper as a whole. The section numbering follows the schedule of the onsite visits.

1. Miyako Island Mega-Solar Demonstration Facility

Today, energy is at the forefront of the global agenda. It is central to the issues of development, global security, environmental protection, and achieving the Millennium Development Goals (MDGs). Moreover, according to existing projections, the world's population of 7 billion is likely to increase to 9 billion by 2050, which means there will be growing demand for diminishing natural

resources, as never before. Furthermore, the provision of electricity to remote rural areas and isolated islands is another serious challenge on the socio-economic development path. Thus, both developed and developing countries need to find innovative new solutions that make better use of the available resources, without compromising the needs of future generations.

Recognizing the existing threats to the global environment related to climate change, along with the urgent need to improve energy security, many countries agreed under the Kyoto Protocol to reduce their greenhouse gas emissions by approximately 20% before 2020. In order to achieve this target the countries have started to shift towards more eco-friendly energy, in pursuit of more sustainable development. At the same time, a challenging physical environment and a low-density population in remote areas has also pushed some countries towards the development of smart grids and independent energy generation facilities. As a result, energy efficiency and support for renewable energies (such as bio-fuels and hydro, wind, and solar power) are now among the top priorities of energy policies many countries.

In islands and remote communities, where grid extension is difficult and fuel transportation and logistics are challenging and costly, renewable energy is emerging as the energy supply solution for the twenty-first century, ensuring reliable and secure energy supply in such communities.

The deployment of renewable-energy technologies is increasing globally, supported by rapidly declining prices and government policies and strategies in many countries. This has resulted in renewable-energy solutions becoming the most cost-effective options in many markets today. For example, in 2011 the Special Report of the IPCC (Intergovernmental Panel on Climate Change) on Renewable Energy Sources and Climate Change Mitigation showed that approximately 50% of the new electricity generation capacity added globally between 2008 and 2009 came from renewable energy sources. Therefore, the future of renewables as the base energy source for islands and remote communities looks very bright.

One of the most promising renewable energy sources is solar power – it is the cleanest and most abundant energy source available. The potential of solar energy is beyond imagination. According to the International Energy Agency (IEA), the surface of the earth receives around 120,000 terawatts of solar radiation (sunlight) – 20,000 times more power than what is needed to supply the entire world. Solar power generation, which produces electricity without emitting CO_2 and provides clean and renewable energy, is becoming increasingly popular around the world. Obviously, its availability is greater in warm and sunny countries – those countries that will experience most of the world's population and economic growth over the next decades. Although, there are emissions associated with the manufacturing, transportation, and installation of solar power systems, these are negligible compared to most conventional

energy sources. Needless to say, the development of solar energy will significantly reduce our dependence on non-renewable energy sources, and it is an important step in preventing climate change.

Japan is well known as a leading country in the promotion of alternative energy and the reduction of greenhouse gases. In addition, the country's topographical factors, the heavy dependency on imported fossil fuels, and the remote locations of some islands at a distance from the mainland all create additional incentives to develop solar powered generation, as a potential solution for meeting the energy needs in remote territories in Japan.

However, the large-scale introduction of photovoltaic (PV) power still needs further research and development, mainly due to its high costs and abrupt output fluctuations. It is necessary to encompass a range of measures to manage this variability, including a balanced-supply technology portfolio, better forecasting tools, demand side management, and appropriate energy storage solutions.

In this regard, recognizing the vast potential of solar power contribution to the overall goals of Japan's energy policy, the government of the country (through the Ministry of Economy, Trade and Industry) decided to support research and development of large-scale PV power generation. As part of this, in 2009 they subsidized the project called the Mega-Solar Power Demonstration Facility in Miyakojima (Okinawa Prefecture), with the main objective to find solutions for existing obstacles in the installation of large-scale photovoltaic equipment into the small independent grid of isolated islands.

Miyako Island is an ideal location for this research, due to its characteristics. It is 300 km away from the Okinawa mainland, and it is approximately 205 km^2 in size, with a population of 55,000 people and approximately 25,000 houses. The average temperature on Miyako is a balmy 23°C. The island is in a location where typhoons often occur, so the photovoltaic panels have to be installed with heavy-duty supports, capable of withstanding strong winds. The panels were also inclined at a 5 degrees angle, to help prevent the wind from catching them, and to minimize the installation area. The photovoltaic research facility has 4,000 newly established PV systems, with a capacity of approximately 50,000 kW per year – this gives an estimated CO_2 emission reduction of 4,000 tons per year. This is complimented by the addition of NAS (sodium-sulfur) storage batteries to cope with the unstable power quality of the energy produced from the PV. The NAS battery is free of self-discharge, and it features high-energy density and high efficiency. It is probably one of the key elements of the project, and it is very expensive – with the average cost exceeding US$ 10 million per item. Large capacity batteries of this type have to be made especially for the facility. The NAS battery is excellent in response performance and can absorb abrupt fluctuations of PV output that cannot be compensated by a thermal generator. It should be noted, however, that it is necessary to maintain specified temperatures in the inner

cell by a heater, since sodium and sulfur are used in their liquid state.

As we have learned from the visit to the Miyako Mega-Solar power facility, after converting solar energy into electricity using a PV cell made of a semiconductor material, there is a need from time-to-time to adjust the supply and demand equally, to ensure the nominal frequency (60Hz) remains constant. In order to do that, it is necessary to fine-tune the output of the generators. If supply is less than the demand, the frequency decreases, and if the reverse supply is greater than the demand, then the frequency increases. If the balance between supply and demand is not kept at a constant level, the frequency will fluctuate. This has the negative result of poor power quality, which has an impact on the quality of manufactured products in factories.

The project has developed a special simulated power distribution system for determining the impact of the introduction of large volume PV-power generators into the distribution system, and to demonstrate the effectiveness of the stabilization of the system. This system is equipped with polycrystalline silicon and thin-film silicon PV panels made by Sharp, Kyocera, and Kaneka. Each manufacturer offers different advantages, such as high conversion effectiveness, product life time, or maximum output capacity. Sharp has the largest number of panels, due to its superior technical characteristics and cost efficiency. In addition, the system is divided into four consumer blocks supported by eight NAS batteries (0.5 MW), a step-voltage regulator (SVR), and a Static VAR Compensator (SVC). The line length of the simulated power distribution can be set as desired in the range of 0–20 km.

An interesting fact about this system, which is operated by the Okinawa Electric Power Company (OEPC), is that it can simulate an ordinary household and school load (4 kW and 150 kW PV respectively), to determine the optimum capacity of storage, while also studying the prediction technique of the PV output, for a more smooth system operation. It also provides a 4 kW lithium ion storage battery for 25 residencies as an additional part of the monitoring.

The project also aims to validate the frequency fluctuation control effect of the following combination: storage battery + PV + wind turbine. However, since the wind turbine power is a separate subject, this report is focused only on the aspects related to solar power generation and its distribution.

The technologies presented here are not currently cost competitive with the storage technologies discussed above. However, they are under development and may someday become mainstream technologies. Since the research and development (R&D) focuses on improving technical performance, rather than cost reduction, and there are few or no full-scale installations of these technologies, reliable cost data are generally not available for these technologies.

The storage technologies are undergoing rapid advancement, and there is as yet no clear leading technology. However, as experience

with these technologies grows, their advantages and constraints are becoming clearer.

There are several interesting implications of this project. For instance, adding the storage significantly increases the initial cost. However, according to some estimates it also allows for a 25% reduction in diesel use. It does so largely by allowing the diesel generator to operate at higher loads (and thus higher efficiencies) and to switch off entirely when loads are low, as was explained to us during our visit to the Miyako Second Power Station and the Miyako Gas Turbine Station. However, it is important to have a precise prediction of the load, since diesel power is very slow in reaction, and it may take around two hours from start up to having the engine working at the required level. The gas turbine is faster and it is often used to compensate for the gap that occurs during peak times, so this combination is also used in certain situations.

PV as a supplement to a diesel generator, without the accompanying storage, is unlikely to be a financially attractive choice – although it may be worth considering as an interim step to the introduction of PV technology on a large scale. The combination of diesel generators, solar power, and storage may be the lowest cost option, based on the levelized energy cost. However, such systems are complex and technologically sophisticated.

In this regard, the Miyako Mega-Solar Demonstration Facility has very clear objectives and expected outcomes, such as to:

- Validate the methods of controlling fluctuations caused by sudden output from the PV
- Determine the required capacity of the storage battery
- Study the techniques of predicting PV output
- Study the techniques of predicting the remaining power in the storage battery

If the project is successful in meeting its expectations, then it will be a significant step towards the development of alternative energy and the provision of electricity to remote areas, as well as the reduction of greenhouse gas emissions. In addition, it will have a global impact, by contributing to the spread of PV power in developing countries via knowledge sharing and the transfer of technology.

Of course, the financial aspect still remains a key obstacle to the introduction of solar power. However, high efficiency solar cells help to lower the overall cost of solar power, but that only accounts for half of the costs related to a typical solar installation. The other half consists of operation and maintenance, grid integration, and so on.

Nevertheless, with effective policies in place, PV on residential and commercial buildings could achieve grid parity – i.e. with electricity grid retail prices – by 2020 in many regions. In this scenario, utility-scale PV could become competitive in the sunniest regions by 2030, and provide 5% of global electricity by 2050. As PV matures into a mainstream technology, grid integration, management, and energy storage remain the key issues. The feed-in tariff

can be a good tool for the stimulation of renewable energy, but it will also have its limitations and possible side effects. Therefore, it is important to have a complex approach, with incentives to private households to use PV power for long-term energy security and more sustainable development. In this regard, the Mega-Solar Power Demonstration Facility is an important project for unlocking the potential of solar power, and can significantly help to provide access to clean, reliable, and affordable energy that has a profound impact on multiple aspects of human development.

2. Science and Engineering perspectives

This section will show two further technical ideas, with perspectives from the Science and Engineering students on wind- and solar-powered generation.

2.1. Wind-power generation systems

Wind energy is one of the oldest energy systems, invented more than 5,000 years ago in Mesopotamia and Egypt. Wind power is also a famous symbol of the Netherlands, although most of their windmills were not built until around the fifteenth century. As this shows, human beings have been constantly trying to develop new resources. James Watt, in Scotland, in the United Kingdom, responded to one such practical challenge by inventing the steam engine. In doing so, he started an era that depended on fossil fuels, shifting from a previous dependence on natural energy sources.

The windmill, however, remained an important piece of technology, even when new resources were developed. Why did it not go out of use? In my view, it might have been because of people's preferences. For example, the wind-power generators receive attention from the tourism industry, and remain functional as the focus of tours. In this sense, it may work and it is not a bad idea to use it as a landmark. However, in practical terms it cannot be said that the wind-power generator makes a significant contribution. According to the data from NEDO,[1] the output of wind-powered generating plants, and other power plants, are as follows:

- Thermo power accounts for 3,000 times more output than wind power
- Water power accounts for 300 times more output than wind power

It is important to recognize that this shows very significant differences between the types of energy production from natural fluids. However, the aim is to shift away from fossil fuel energy towards a final goal of much greater use of renewable energies. This would largely result in a move from thermo-power generation to wind-power generation, and to do this requires the closing of these significant differences. At present, this aim does not appear to be realistic.

[1] NEDO, 日本における風力発電設備・導入実績 http://www.nedo.go.jp/library/fuuryoku/index.html

One of the methods to increase the output of wind power is to make wind-power generators larger. The formula for calculating this is as follows:

$$P = 1/2 \cdot \rho \cdot S \cdot V^3$$

Where P is wind-power energy (W), ρ is air density (kg/m^3), S is the area of bladed wheel (m^2), and V is wind speed (m/s). By Betz's law, the wind-generating power can expand in proportion to the area of the bladed wheel.

In Germany, a 6,000 kW wind-powered[i] generator is being developed. However, it is doubtful whether this level of power could be reached with a hydroelectric generator, because it would be very difficult to develop one of sufficient size.

Moreover, the rate of utilization of thermo, water, and nuclear-power generation is decided by each project. However, it is difficult to rely on wind and solar-power generation (which we will describe in the next section) for the provision of 100% of energy use, because the providing resources (wind and sunshine) are unstable and unpredictable natural energy resources. Even if it works, the wind does not blow in sufficient strength everywhere. Miyako Island has optimal conditions for wind-power generation because of its frequent sea breezes. There are few other places in Japan where similar conditions can be assured, and it is difficult to build in places near where people live. Moreover, it may interfere with fishing activities, and cause conflicts amongst local residents. From these points, the wind-energy power generation does have very strong disadvantages.

2.2. Solar power generation

Solar-power generation can maintain a more stable level of generating power if the weather is fine, in comparison with wind-power generation, because it has fewer restrictions on location. It needs less equipment maintenance than other types of energy.

Also, as NEDO and other institutes have shown [2-4], if we could spread solar cells across the Gobi Desert, it would produce enough energy to fulfill whole world's current energy usage. On this basis, solar-power generation appears an ideal energy resource.

However, in practice this is not a realistic idea. There are two reasons: costs and time. First, the costs of the solar cells are very high. Second, there are significant additional costs for the transformation of the electrical energy produced, and the transmission of this power to distant places. The transmission requires not only costs but also energy. Moreover, as we learned from this onsite field trip, there are further costs for the storage of power from solar-power generation.

With regard to the time, this idea is also unrealistic because of immense area required. Even though, as I noted above, the idea of covering the Gobi Desert seems sustainable and clean, the scale works against it. The area of the Gobi Desert is approximately 130×10 km^2, and it is approximately 3.5 times greater than the area of Japan. Even if the solar cells were

spread at the rate of 10 km^2 per a day, it would take more than 360 years to complete the task.

Since the massive earthquake and tsunami struck Japan in 2011, there has been considerable thought and discussion about the diminution of nuclear-power generation. We would like to now discuss the possibility of solar-power generation as a substitute for nuclear-power generation. Solar-generated power is 1×10^6 kW, which can easily match the output of an atomic power plant[2].

It is necessary to produce 8.33GW, which is calculated with an average of 12% for the utilization factor of solar cells in Japan, and the conversion efficiency is set at an average of 10%. Sunlight provides around 1 kW/m^2 at ground level, and so the power output is 100 kW/m^2. So, the necessary area for solar-power generation, in substitution for a nuclear-power plant, is 83.3 km^2, which is the approximate equivalent to 1,800 times the size of the Tokyo Dome. That is to say, it is not realistic to think that solar-power generation can replace nuclear-power generation in the present circumstances in Japan.

3. Miyako Second Electric Power Plant

The Miyako Second Electric Power Plant is located in the northwest coast of Miyako Island. With a further two internal combustion power plants, the total electric-power generation capacity is approximately 74,000 kW. These power plants also service Irabu Island, which lies to the west of Miyako Island. The demand for electricity in Miyako Island and Irabu Island is at most 550,000 kW in the summer. Because there is no large-scale factory in the islands, and so the main demand for electric power comes from civil households, the peak time for demand is from 7 p.m. to 8 p.m.

When we visited Miyako Second Electric Power Plant in the afternoon, the generating power was approximately 30,000 kW. Most of this (26,000 kW) came from the internal-combustion power plants. At that time, the remainder (4,000 kW) was from wind-power generators and solar-power generators. The maximum ratio of renewable energy that is available to be produced in the islands is 25% of the total production.

3.1 Internal Combustion Power Plant

The Miyako Second Power Plant has four diesel-powered generators. The electric-power generation capacity of each generator is 10,000 kW. This means that the total capacity of the Miyako Second Power Plant is 40,000 kW.

The second power plant uses a V-type 8-cylinder twin diesel engine. Unlike other diesel engines that consume light oil, these engines consume heavy oil. The power plant has forty days of oil-storage for emergencies, especially for the typhoon season when oil tankers may be unable to approach the island.

The generating power of the internal combustion power plants is automatically controlled by computer, to adjust to the

2 関西電力, 原子力発電所の運転状況
http://www1.kepco.co.jp/gensi/monitor/live_unten/u_real.html

generation of power by renewable energy. Since the generation of power from renewable energy fluctuates depending on the weather conditions (that is, wind and sunshine), it is necessary to adjust the fluctuation of other electricity generated. However, the diesel-powered generator cannot be controlled quickly in response to weather changes. For this reason, storage batteries are used to adjust to the fluctuation of power generated from renewable energies.

[Figure 1]
Diesel-powered engine generator

[Figure 2]
Control Monitor

Gas Turbine Power Plant

In addition to the diesel-powered generators, Miyako Island has a gas-turbine power plant. The gas-turbine power plant is smaller and cheaper to build in comparison with the diesel-powered generator. However, the gas-turbine power plant in the island is only for emergency use because its generating efficiency is lower than the diesel-powered one. They have three gas turbines whose generating capacity is 5,000 kW each, and so the total capacity for the gas turbine power plant is 15,000 kW.

Small Hydroelectric Power Plant

The Miyako Second Power Plant also has a small hydroelectric power system, which uses discharged engine-cooling water. The engine cooling water falls from a height of 13 meters into the ocean. The stream of this waterfall rotates the water turbines and produces electricity. The maximum capacity of power generation from this is 65kW.

Challenges and Personal Review

The electricity generation systems in Miyako Island have some challenges which need to be addressed for them to become more reliable, suitable for installation in other places. The main challenge is how to stabilize the frequency of the electricity. It is still difficult to control the frequency of the electricity from renewable energies, which often fluctuate with the weather conditions. While such a fluctuation of frequency is acceptable in Miyako Island, where almost all electricity demand comes from domestic households, it is unsuitable for other regions with precision machine factories that require exact electric

frequency.

In the lecture, it was said that “high-quality electricity” means electricity with a stable frequency and voltage. According to the lecture, it is easier to stabilize the frequency and voltage with a large-scale energy source such as thermal-power and nuclear power plants, rather than with small-scale renewable energy sources. Once renewable energy is installed into an electric-power network, the quality of electricity will decline.

However, in my personal opinion, this does not create the necessity to rely more on large-scale energy sources, which have many

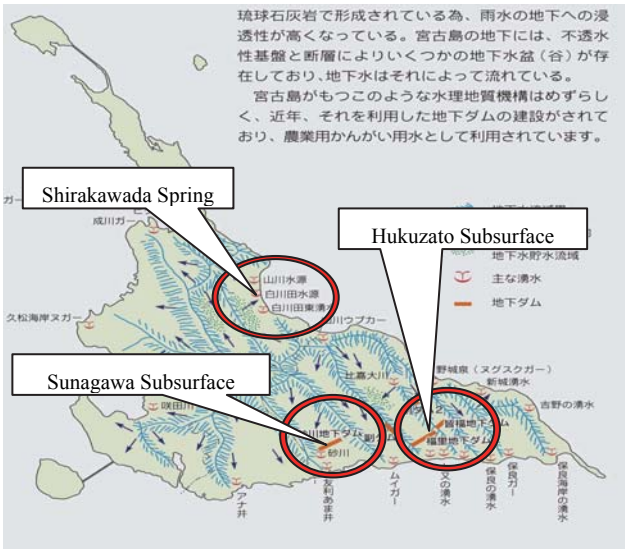
[Figure 3]
Small Hydroelectric Power Plant

risks, such as uncontrollable nuclear reactions, or global warming. What we should do is not only develop new energy sources but also reconsider the ways we consume energy. So long as it is not possible to achieve perfectly sustainable, reliable, stable, safe, and clean energy, it is necessary to rethink our society, and our own lifestyles, and reduce our energy consumption.

4. The Museum of the Subsurface Dam in Miyakojima Island

Japan has many water resources, such as rivers. However, Miyako Island does not have this. So how do the people in Miyako Island get the water they need for drinking, agriculture, and so on? The answer is that they depend largely on the Shirakawada Spring for drinking water, and the Sunagawa and Hukuzato Subsurface Dams for agriculture. This section will discuss the mechanism of the subsurface dam, which was provided at the Museum of the Subsurface Dam, and then as a conclusion, the author will make some remarks on the visit to the dam.

Map 1 shows the locations of the Shirakawada Spring, and the Sunagawa and Hukuzato Subsurface Dams. The spring is mainly for the drinking water and the two dams are for agriculture. The total volume of water kept in storage in the two dams is 20 million tons, which makes it 16 times larger than the Tokyo Dome. The breakdown is that Sunagawa is 9.5 million tons and Hukuzato is 10.5 million tons. Their total length is 4.6 km and the maximum height of the wall is 60 m. It is no exaggeration to say that the two subsurface dams sustain the farming in Miyako Island.



[Map 1]

Map Source: 宮古島市上下水道部「宮古島の上下水道」19頁。 http://miyakojimajyouge.jp/2011panf.pdf downloaded on March 16th, 2013. The author tidied up the figures on the map.

How were subsurface dams constructed? Figure 4 shows the construction model of a subsurface dam. The yellow-collared large machine tools are called tri-axial auger drills (三軸オーガードリル) and their height is about 25m. The tri-axial auger drill has three axial drills as the name implies. The drills dug down until they reached the Shimajiri Mudstone layer, which is the third layer of soil from the surface of Miyakojima Island (Figure 6 below shows the soil layers). These large holes were dug at 90-cm intervals. The axial drills were extracted from the holes whilst cement was poured into them.

[Figure 4]

The construction model of a subsurface dam at the Museum of the Subsurface Dam in Miyakojima Island.

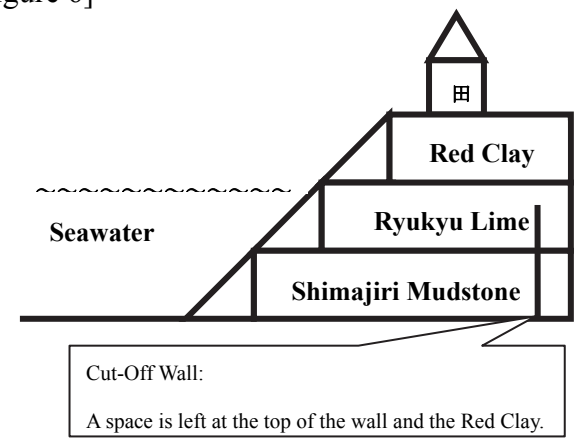
[Figure 5]

One of the cut-off walls of the Hukuzato Subsurface Dam

After the drills were pulled from the holes, the dirt which was produced during digging was put back to the holes. Then, finally, the cut-off walls were completed. Figure 5 shows one of cut-off walls of the Hukuzato Subsurface Dam. To prevent the water flooding from the dam during heavy rain, there are some spaces between the top of the wall and the soil,

called Ryukyu limestone, which is the second layer of the soil from the surface of Miyakojima Island. Because of the way in which the dams were constructed, and also due to their location, the water in the subsurface dams has very little plankton, and it is possible to use the surface of the island for farming. Figure 6 shows the soil structure of the island.

[Figure 6]



The water content of the red clay is only about 10%. Most rainwater is not retained in the soil; it flows into the sea. Therefore, it is really important for the island to have this kind of dam.

The suitable conditions for the subsurface dams are that: first, the soil allows water to flow through it easily; second, the land has a lot of rain; and finally, the topography of the underground is like valleys. Thus, Miyakojima Island is suitable for subsurface dams.

The system for the distribution of the water from the dams to the farm land is very simple. There are a number of wells located around the dams, and the water drawn from them goes into farm ponds. Then, the water is distributed directly to the farmlands thorough pipelines.

In conclusion, the subsurface dams in the island are constructed in a way that utilizes the topography very well. At the same time, the land of Miyakojima Island is flat and there is little difference of altitude between the sea level and the top of the highest hill. Because of this, the water collected into the ponds is easily distributed to the farmland.

It would probably be difficult for developing countries that face water shortages to introduce this type of dam. In the case of Rwanda, which has a lot of rain, the construction of such dams appears suitable, and they would have a positive impact because agriculture is its main industry. However, it would first require some research into its stratifications. Also, the location of the country is problematic, as Rwanda is located at an altitude between 1,500 m and 2,000 m (and more in some places). At such a high altitude, it may be hard to develop efficient techniques for drawing and distributing the water to the farmlands. From the perspective of their maintenance and management, it would be impractical for Rwanda to introduce subsurface dams into their country. However, the structure of these dams could be applied and developed in Rwanda in some way.

4. Visiting the water and sewer division of Miyakojima City

In this section, we will make a report based

on the lecture of Dr. Kajiwara, and add other information as appropriate. Dr. Kajiwara is an expert on water resource management in the Miyakojima City office. He has also been working on providing technical assistance to the Independent State of Samoa. In the first part, I would like to mention problems related to the water-management system, and what has been done in Miyako Island. In the next part, I will cover international cooperation that the Miyako-jima City water authority is involved in. I will go into more detail about problems in the water-supply business in the last section.

4.1 Between cost performance and public welfare

Water is the most essential element for life, and so securing safe drinking water is an urgent issue for all of us. As Dr. Kajiwara said, a water authority is a public "business." Needless to say, the primary responsibility of a water authority is to ensure a water supply and to provide safe drinking water to the people. In addition, a water authority should be independent financially and politically from other administrative systems. All the costs, including the labor, and the maintenance/operation of the facilities and systems have to be financed by the water fee. The administrative officers have to place importance, to some extent, on the perspective of cost performance. What they have to consider, in particular, is whether the water fee can cover the costs associated with the infrastructure.

It is commonly acknowledged that Japan has a high standard of water purity for tap water, and that we have access to clean and safe drinking water anywhere. The number of characteristics to be inspected is about 3 to 4 times higher than that of bottled mineral water. The water quality standards have to comply with the Waterworks Act requirement. It also has to be based on the result of the examination of water carried out by local government. On the other hand, the safety inspection of mineral water is based on the Food Sanitation Act.

Because of these structural peculiarities, there is inevitably a dilemma between public welfare and cost effectiveness. If the water fee becomes too high, it could make water inaccessible for some people. In what follows, I will introduce the practices in Miyako Island.

Miyakojima City consists of six islands — Miyako, Irabu, Shimoji, Kurima, and Ogami. The total population is 54,663 (2010 Statistics), and 99.95% of them are served by the water supply. In Miyako Island the available water resources are limited, as with most other island areas around the world. Moreover, the environment for the existing resources is unstable. Because there are no fresh water resources on the surface of the ground, the city has to depend on groundwater in order for the acquisition of the water supply to be stable.

Miyako Island was known as a "no-water land" for a long time. Obtaining water was an urgent priority for the islanders. It is noteworthy that Miyako Island enacted Japan's first ordinance of groundwater conservation in 1965, based on the concept that the groundwater resources were for public use.

However, the groundwater is vulnerable. It is easily affected by the condition of the surface of the ground. What was written in the novel *Silent Spring* could easily occur. Once pesticides have polluted the groundwater, it will take a very long time to be clean again. So if one pursues cost effectiveness, then s/he also has to be environmentally conscious. However, if remote islands want to survive, they have to rely on resort development. This is also a difficult problem that we should bear in mind.

There are also some geological characteristics to be considered. In Miyakojima, water is pumped up from the limestone layer, so the water contains high level of minerals, such as magnesium and calcium. So there is a need to reduce the water hardness to make it smooth for drinking. However, soft water is easily oxidized and it could cause the water pipes to rapidly spoil. Therefore, the Miyakojima water division set a standard to keep water hardness around 100 mg/l.

Above all, the water pumping and the other special water-treatment processes consume electricity. The small population and the absence of major consumers may cause a decline in water fees collected, and this may push the system into a negative spiral. There is need to create a social system that ensures the water project is sustainable.

4.2 Feedback on the experiences of others

The Miyakojima city office has joined an international cooperation project with the Independent State of Samoa, which is located in the middle of the Pacific Ocean. Dr. Kajiwara told us that the problem in Samoa is not the shortage of water. The main problem is with operation and maintenance. According to an estimate, the leakage rate in Samoa is 60 to 80%, and there is no accurate map of the pipe reticulation.

One of the most difficult issues here is the misunderstanding of water treatment. The project aims to introduce a slow-sand filtration system, which is an ecological-purification system (EPS). EPS does not need electricity or chemicals. In addition it costs very little, has a low impact on the environment, and it is highly adaptable to disaster. However, if there is a misunderstanding of it operation, then the system might work in a counter-productive way.

EPS has been empirically shown to purify water, and the latest study claims that the microscopic ecosystem is the key factor. For it to work, it is necessary is to keep the algae alive, which requires enough light and a suitable tank, which is round-shaped.

EPS's purifying speed is not actually "slow," and in high-temperature areas the system can be very effective. So the filtration time can be reduced to a large extent in a hot weather area like Samoa. In the Sodeyama treatment plant, where 70% of water needs are supplied for residents and tourists, there are nine ponds and seven of them are in operation. The filtration speed is 7 meters a day, and that is enough for around 70,000 people. In Samoa, the temperature is higher than Miyako, which means they can achieve a higher speed.

In Dr. Kajiwara's lecture, there were several points worth noting. First, an administrative officer cannot put new scientific knowledge or theory into practice immediately. If they have no confirmation of safety issues, they cannot even try these ideas, because peoples' lives depend on it. Second, I keenly feel the need to negotiate the "acceptable risk." Zero risk is impossible. What we have to do here is to negotiate to what extent we can accept risk.

Third, international cooperation is not just helping others, but also getting feedback from their experiences, and using it to improve our own practices. In Samoa and Japan alike, people have a strong adherence to high-tech. Japanese experts have introduced in Samoa some basic skills and techniques, such as using a listening bar for leak detection. I also feel that now we are at the point of rethinking our methods. We should review basic and simple methods in order to maintain the systems by ourselves. Forth, we need to adjust our approach to suit the conditions of each area. For example, in Samoa each community controls their water resources. This is the principle of the community, but there is not a concept of the broader public. What they do there is to deal with the situation within the framework of their own culture's understanding of the issues. This can be applicable when we operate water management systems in Japan, for we have different social relations and systems, and a particular environment.

4.3 The future of water management in Japan

In this part, I will discuss the current situation in Japan regarding the water supply business. It is said that in the future around 70% of smaller municipalities will not be able to handle the water supply business by themselves. Throughout Japan, there are about 43,000 km of end-of-life water pipes.

There are three conceivable problems: financial, technical, and operational. Due to financial difficulties and falling populations, more and more of the smaller municipalities are facing difficulties in operating and maintaining their facilities. In fact, water-pipe related trouble, such as bursting pipes, is increasing. To improve the situation, we need to make use of the merit of scale. As you see, smaller municipalities do not have the significant "scale" in the first place. However, some private companies are able to manage the inter-municipal water supply business.

There are also problems in technical transfer. Local governments exclusively take a role in the water supply business, so private companies do not have the know-how. If foreign companies came into the Japanese market, Japanese companies might then be thoroughly excluded. We should be more careful about developing private companies in the context of public-private partnerships.

However, a small and isolated island like Miyakojima cannot rely on the merit of scale. So I think to some extent, they have to rely on subsidies from the government. Miyakojima is under the Remote Islands Development Act, and it is also one of the remote islands regions

prescribed in item iii of Article 3 of the Okinawa Promotion and Development Special Treatment Act (Act No. 14 of 2002). However, it seems the subsidy mostly goes to *hakomono* (boxed) areas, such as concrete construction, or logistic expenses.

We, and the government as well, have to be more serious about the water-supply business, or we will not be able to obtain safe drinking water in the near future. In the midst of globalization we have to pay attention to world trends, even if it is public works that are involved. In terms of international cooperation, we have to find out what are our advantages, based on our international relationships. As Dr. Kajiwara told us, we have learned from the history of ODA that it is very important to take time and build up relations based on trust. In terms of our internal affairs, we can learn from what is going on outside Japan. It is reported that major international water companies go in and purchase local water-supply businesses, and then they raise the price of water on a unilateral basis. We cannot say this will not happen here in Japan.

We could learn many lessons from the experience of Miyako Island. What we have to do is to try to make the most of these lessons, and try to get the situation improved.

Conclusion

The experiments in Miyako Island make good use of their environment, industry, and life style. These may not necessarily be put into effect easily in some other situation, even in the same country. For instance, as it was described above, the wind-powered generators cannot generate electric power if the wind does not blow continuously. The solar-power generators cannot work so well if there is no sunlight, and also the large population groups can easily influence it. And the solar panels need a large area if they are going to supply enough power for high-energy consumption. The hydroelectric power generators need a water resource and a head of water. Moreover, it is put in place within the context of the local life style and its demands. As there is no factory with precision machinery in Miyako Island, it can be said there are fewer challenges for a renewable energy plan, other than the environmental conditions. In the mainland of Japan, it is essential to maintain a high quality of electric power for the precision machinery, so the use of renewable energy needs to be considered carefully.

When we see the news about the energy resources and the energy problems, we often do not understand that some of these issues are quite simple. Also, as Miyako Island has a severe environment, the way that the problems of Miyako City have been tackled might give us some keys for dealing with the same problems elsewhere.

Visiting the four facilities in Miyako Island has not only widened and deepened our understandings about the infrastructure of renewable resources. It has also helped us realize what we need to learn for the future in our study on the GRM program. For instance,

during the lectures and explanations, social science students have encountered their lack of knowledge of science and engineering. There are pros and cons for this. However, it has made it more clear what kind of basic knowledge we need to have to help us learn further. For science and engineering students, the lectures gave some clues and key points such as why we should promote international cooperation, and what we have to care about when we are working internationally.

Also this field trip gave us an opportunity to understand the infrastructure of systems by experiencing them first hand. It is required of GRM students to do our best to make use of the knowledge we have acquired, and we have to keep learning the basics, along with these various cases, as it enriches our studies.

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Onsite training course at Rishiri Island

Date: August 18-21, 2013
Venue: Rishiri Island, Hokkaido

The Global Resource Management program led an onsite training course at Rishiri Island in August 2013. Rishiri Island is located 20 km northwest of the main island of Hokkaido, Japan and has a declining population of 2,811 people, as of 2013. Due to its small size and its separation from the main island, Rishiri Island is not connected to the power grid. Thus, all of its energy has to be produced within the island. The objective of the onsite training course was to assess the possibility of implementing renewable energy systems to improve the living standards of the community, and to reduce its current dependence on fuel shipments from the main island.

The onsite training course started with a tour of the power-generating facilities. Currently, Rishiri Island has an electricity generation capacity of 8,145 kW, which is obtained using three different energy resources. Diesel engine generators account for 7,650 kW of the total capacity, using a total of eight engines. Two micro-scale hydroelectric generators are available with a total generation capacity of 245 kW, and lastly, a single 250 kW wind turbine has also been recently installed. Out of the three power generation systems, hydroelectric power has the highest utilization factor, operating constantly throughout the year, with only a slight decrease in output in the winter. Diesel generators are the most reliable system, since they can be managed to quickly adapt to load variations. However, they are fully dependent on diesel oil, which must be regularly transported from Wakkanai to Rishiri Island by ship, and heavy storms might suddenly stop the transit of the ships.

250 kW wind turbine in Rishiri Island

The power facilities tour was followed by a lecture at the municipal office of Rishiri Island, where the current state of and future plans for infrastructure development were presented. A feasibility study of renewable energies in Rishiri Island showed that the most promising option is wind energy, with an annual usable capacity of 6.7 TJ, followed by solar photovoltaics with 1.7 TJ. The current plan for replacing the diesel generators with renewable energies is still, however, not enough to completely cover the energy demands of the island. Especially in the winter when electricity is most needed, solar photovoltaics becomes less reliable due to shorter hours of sunshine and adverse weather conditions, such as cloud cover and snow on the panels. Since solar photovoltaics accounts for 15% of the installed power generation in the current plan, heavier dependence on diesel generators may be expected during this season.

The onsite training course was complemented with lectures from invited guest speakers from the University of Philippines. Similar problems with energy infrastructure are present in the Philippines, due to it being an archipelago country. The water and energy infrastructure industries in the Philippines were presented, as well as the major problems that have been faced. These insights were helpful to the students of the GRM program to analyze and

discuss the current state of Rishiri Island and its capacity for social growth.

In conclusion, Rishiri Island does not face an easy situation in terms of replacing its power generation systems with renewable energies. Although the island still has available to it several unused energy resources, its energy demands are mostly for heating, which is more complicated to obtain than electricity. The decrease in population also brings into question the justifiability of implementing this project. Nevertheless, the inhabitants of Rishiri Island have the right to demand improvements in their energy infrastructure. With careful planning, this project might bring benefits to the island in both reduced costs and energy independence.

(Jorge E. Lamas, Graduate Student,
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Fieldwork Report 1
A Study of the Role of Education in Unity Building and Conflict Prevention in Rwanda

Megumi Inaka
(Master's Student, Graduate School of Global Studies)

My study examines the role of education in unity building and conflict prevention in Rwanda after the 1994 genocide. Focusing on Rwandan education, I investigate how education contributes to reconciliation, and what educational methods the government and schools have employed to promote peace. The overarching goal is to determine what role education should play in helping the country recover from conflict. I also aim to identify educational methods that are effective in preventing the resurgence of conflict.

1. Objective of the Fieldwork

The principle objective of this fieldwork in Rwanda is to assess the existing condition of education under the reconciliation policy and to understand the challenges it faces.

2. Fieldwork Outline

This fieldwork was conducted between September 5–22, 2013. During this time, I carried out the following activities: (1) observed existing educational conditions through volunteer work at the UMUCO MWIZA academy in the capital city, Kigali; (2) interviewed a history teacher at a public high school, young people working at a market, and a staff member of REACH (Reconciliation Evangelism and Christian Healing), an NGO working for healing, reconciliation and sustainable development after the 1994 genocide; (3) visited a rural community, Bugesera, while taking part in an activity organized by the NGO Plan Rwanda; (4) visited genocide memorials and the Protestant Institute of Arts and Social Sciences.

3. Outcomes

This research did not progress as originally planned due to incidents such as the pre-election bombing in Kigali, Rwanda. However, unexpected gains, including interviews with a REACH staff member and a high school history teacher, helped to create a fruitful outcome.

By volunteering at the UMUCO MWIZA academy, interviewing young people working at a market, and visiting a rural community in Bugesera, I became familiar with the difference between urban and rural schools and learning environments, as well as between the rich and the poor in Rwanda. For example, there is a substantial gap between urban and rural living conditions and infrastructures; this affects the educational environment for children. In the rural community I visited, the children's class schedule was divided into morning and afternoon sessions, reflecting both restricted classroom capacity and the demand for child labor. I also observed a gap between private and public schools, with public schools having far fewer school supplies, materials and resources than private schools.

Interviews with a staff member of REACH and a public high school history teacher generated many findings about the present condition of reconciliation and the effect of genocide on post-genocide education. According to the REACH employee, reconciliation had so far been promoted through the law prohibiting discrimination and activities that gave people opportunities for atonement. However, he said, it was still essential to make an effort. Education is one means to achieve reconciliation, according to the history teacher. To create unity and avoid genocidal ideology, schools offer several programs, including club activities during which students can learn about the causes and consequences of the genocide from the viewpoints of both ethnic groups: Hutu and Tutsi. In addition, physical education has a

large role to play in fostering harmony. The most important point, he said, is to tell children the “whole truth.”

4. Future Tasks

This fieldwork helped me to understand the current state of post-genocide education and the reconciliation process in Rwanda. In future, I plan to investigate the effectiveness of post-conflict education and, in particular, those programs that aim to bring unity. Through organizations such as the NGO Plan Rwanda and the National Commission for the Fight Against Genocide (CNLG), I hope to conduct in-depth research into post-genocide reconciliation programs and the educational environment for children in rural areas.

Fieldwork Report 2
Bosnia and Serbia

Tomotaka Teshiba
Keisuke Kagami
(Master's Students, Graduate School of Policy and Management)

We conducted GRM fieldwork in Bosnia and Herzegovina and the Republic of Serbia between September 3–12, 2013. The aim of this fieldwork was first, to visit two countries where conflicts had occurred to investigate the current state of those conflicts and reconstruction efforts, and second, to participate in two seminars held in Serbia, giving presentations on our subjects of study.

We stayed in Sarajevo, the capital of Bosnia and Herzegovina from September 4–6. On the first day, we visited the Sarajevo Tunnel Museum. A small section of the tunnel had been dug for the Bosniak armed forces and used to carry various goods during the Bosnian war. We walked down the narrow, low tunnel and experienced their struggle to transport goods.

In exploring the urban area of Sarajevo, we saw the beautiful Sarajevo cityscape. However, there are still many buildings riddled with bullet holes. We could imagine the violent gunfights that took place during the Bosnian war. Sarajevo is inhabited by Muslim Bosniaks, Orthodox Serbs, and Catholic Croats; the city is home to both Islamic and Christian cultures. There was once a brutal war between these ethnic groups in Sarajevo, but they now manage to coexist.

On the second day, we had a meeting in Sarajevo with the Embassy of Japan and the OSCE (Organization for Security and Co-operation in Europe) mission to Bosnia and Herzegovina. We attended a lecture about the Bosnian political situation and the OSCE's support for Bosnia.

On the third day, we went to Srebrenica in the east of Bosnia, where more than 8,000 Bosniaks were killed (the Srebrenica massacre, in 1995). At the Srebrenica Genocide Memorial, over 6,000 victims of the genocide have been buried. Our guide, who had lost relatives during the genocide, told us about its tragedies.

We travelled through Munich and visited Belgrade, the capital of the Republic of Serbia, from September 8–10. On the fifth day, we went to the inner city of Belgrade to conduct fieldwork. We saw the state of reconstruction and the damage from the war.

On the sixth day, we participated in a seminar hosted by the IIPE (Institute of International Politics and Economics). In this seminar, we listened to presentations by other participants, and were each given an opportunity to discuss our own research projects.

Kagami reported on the Reconstruction Agency of Japan. In his presentation, he explained the organizational design of the agency, arguing that it was pulled between two values, fairness, and responsiveness. In his presentation, Teshiba explained why policy evaluation does not work well in Japan, focusing on the transition between objectives in implementing a policy evaluation.

After the seminar, we and the other seminar participants attended a reception at the official residence of the Japanese Ambassador to Serbia. Each of us received comments and suggestions on our seminar presentations. We also enjoyed the party.

On the seventh day, we took part in a student seminar at the University of Belgrade. We were grateful for another opportunity to present our own research. Kagami gave a presentation on the Great East Earthquake of Japan, and Teshiba talked about Japan's relationship to the Olympic Games. After the seminar was over, we went out for dinner and a discussion with other student participants. On September 11–12, we traveled back to Japan.

Through this fieldwork, we acquired a greater level of understanding of ethnic conflicts, and improved our presentation skills in English. By doing fieldwork, we learned to appreciate the complexity of the ethnic conflict and the difficult co-existence of multiple cultures. As to presentation skills, we had two opportunities to give talks in English. As our first presentations were at the international seminar, we felt a great sense of anxiety and accomplishment.

Fieldwork Report 3
A Solution to the Problem of Drinking Water Pollution and Scarcity through a Joint Study with University of the Philippines

Kenta Doi
(Master's Student, Graduate School of Science and Engineering)

Water delivery systems are an indispensable infrastructure in people's lives. The history of social infrastructures, including water delivery systems, has progressed in accordance with human civilization. As representatives of modern infrastructure systems, information technology and electric power have interdependent relationships with the development of new technologies. By contrast, the water service has supported people's lives since ancient times. By the end of 2011, 89 percent of the world population could have access to water from improved sources, including not only piped water but also dug wells and rainwater collections; nevertheless, an enormous number of people still suffer from a scarcity of drinking water [1].

Not all of the world's water delivery systems are reliable. Poorly improved water contains disease-causing microorganisms, toxic chemical substances, and levels of heavy metals at or above the reference value. In the Philippines, just under one third, or 31 percent, of illnesses monitored between 2001 and 2005 had some connection with water-borne pathogens [2]. This problem arises from the pollution of water resources due to untreated wastewater discharge and other contaminants. To address water pollution problems, it is necessary to develop inexpensive and efficient technologies that can reduce the pollution of water resources and/or purify water before distribution.

The application of a photocatalyst is one way to purify water inexpensively and efficiently [3]. Photocatalytic materials decompose toxic organic substances and heavy metal ions such as hexavalent chromium by absorbing light; they also provide sterilization and virus deactivation. This treatment can therefore be applied not only to large water networks but also to small-scale purification systems for dug well and rainwater collection in remote rural areas at a relatively low cost. Consequently, it can also reduce the number of people suffering from water scarcity.

Through the GRM program, I studied the formation of a titanium dioxide (TiO_2) photocatalyst thin film for the purpose of water purification, as part of a joint project with the Plasma Physics Laboratory of The National Institute of Physics at the University of the Philippines in Diliman. Since the film is formed through a process involving chemically reactive plasma in a vacuum container, the first task is to achieve a good vacuum-compatible environment. Given the climate environment of the Philippines, it was not easy to obtain a good vacuum and this impeded our progress. After struggling for six days to prepare the experimental apparatus, we finally succeeded in preparing the thin film. The results of our formed thin film analyses, however, suggested that further improvements should be made to the experiment to ensure a better thin film, suitable for water purification.

Through this process, I learned the importance of communicating the objectives of an experimental group to all collaborators before starting a project. From a macro-perspective, a joint study is undertaken to accomplish one purpose: the main aim of the study. As individuals, however, each of the researchers has a personal objective and motivation for his or her own experiment. To proceed efficiently and pleasantly, therefore, it is of primary importance to communicate the group's main objective to all collaborators, while acknowledging and taking into consideration their personal interpretations of the experiment.

Carrying out the experiment at the UP laboratory

[1] World Health Organization and UNICEF, *Progress on sanitation and drinking-water* (WHO Press, 2013), 8.
[2] L. Escandor, *The state of water resources in the Philippines* (Greenpeace Southeast Asia, 2007), 22.
[3] K. Nakata and A. Fujishima, "TiO_2 photocatalysis: Design and Applications", *The Journal of Photochemistry and Photobiology C: Photochemistry Reviews* (2012), 13, 169–189.

Ms. Villamayor, Ph.D. student, UP, Diliman (upper left)
Prof. Ramos, UP, Diliman (upper right)
Kenta Doi, M.Eng. student, Doshisha Univ. (lower left)
Prof. Wada, Doshisha Univ. (lower right)

Wind power in the UK: existing provision and future development

H. Griffiths, *Cardiff University*

Abstract: This paper describes the UK government initiatives to support renewable energy and details the development of windpower in the context of overall renewables growth. The existing on-shore and off-shore windfarm fleet is described in detail in terms of distribution around the UK, turbine unit size, numbers of turbines and overall farm capacity. Future windfarm developemnt and potential is quantified for both on-shore and off-shore and current and potential impact of wind power on the electricity transmission system is considered. Based on UK government and industry current projections, wind power in the UK is set to make a major contribution to future electricity production and it will be an essential component in meeting future emissions reduction targets.

Keywords : wind energy, renewables, electricity system

1. INTRODUCTION: Wind power in context of increased requirements for renewable generation

The UK government is committed to the development and implementation of renewable energy in order to achieve a sustainable low-carbon economy. The Department of Energy and Climate Change (DECC) has produced a 'road map' [1, 2] which sets a target of 15% renewable energy by 2020. In order to meet such a target for the economy overall, it is envisaged that the amount of electricity derived from renewables will need to increase from 11% (as of Dec 2012) to approximately 30% by 2020. Market support is therefore provided to subsidize energy sources deemed to be most suitable and this currently includes solar photovoltaics and wind farms. The government has produced a 'Levy Control Framework' up to 2020/21 [3] which provides subsidies in the form of 'Renewable Obligation' (RO) tariffs for large generators and so-called 'Feed-in tariffs' (FITs) for small-scale sources. Although there are concerns about the increased costs of supporting renewable, it is clear that, as renewable technologies mature and economies of scale are realized, the costs of production are set to fall. Recently, and in less than a period of one year, it is estimated that there has been a 50% reduction in the cost of solar PV [4] and costs for off-shore wind are also anticipated to fall [5]. In comparison with conventional generation sources, it is expected that under a central fuel price projection, the most economic on-shore wind farm will compete with combined cycle gas turbine technology within a few years [6].

The impact of this government support is evident by the rapid increase in electricity production from renewables of 27% over the past year with a current installed capacity of 14.4GW. Of this total, on-shore and off-shore wind components are 5.3GW and 2.5GW. It is clear, therefore, that wind power is already set as the most significant future contributor to electricity production from renewables in the UK.

Of course, the quantity requirements for electricity production from renewables not only depend on overall renewable energy targets by also on the level of future UK electricity demand. DECC has estimated that UK electricity demand may increase by between 30% and 100% from 2012 to 2050, as a result of the increasing electrification of heating, transport etc. This could raise the UK maximum demand from about 60GW to potentially 120GW. DECC modeling [7] projects a possible renewable electricity generation capacity of up to 72GW by 2030 and a high electricity demand scenario with significant increased electricity generation by renewables for the UK is set out in [8]. Figure 1, shows the growth in electricity production from renewable in the UK over the period from 1990 to 2010, based on EU published data [9].

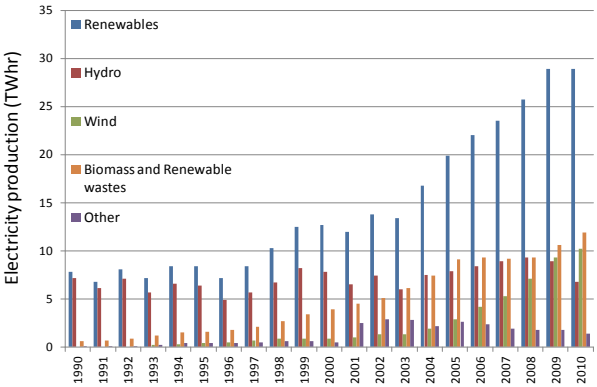

Fig. 1.Gross Renewable Electricity generation by type 1990-2010

From the figure, it can be seen that in 1990, the only significant contributor was conventional hydro with biomass and wind growing steadily over the following twenty year period. More recent rapid growth is evident in wind power generation and this trend is likely to increase. Off-shore wind is seen as the most scalable of the UK's renewable technologies and the UK is currently the global leader by installed capacity and market size [2]. It is considered that there is potential for up to 40GW of deployed off-shore wind generation by 2030 [2].

This paper traces the development of electricity producing wind power installations in the UK from the early on-shore developmental individual turbines of the 1980's to the major off-shore wind farms proposed for the coming decades. The rise in the number and capacity of existing installations is quantified in detail. Details of the turbine sizes, numbers, capacity and capacity

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factor are given and the future development, particularly off-shore is outlined. The challenges of introducing such large quantities of variable electricity generation by wind to the UK electricity network is assessed in terms of transmission capacity and operational security and how such challenges may be met. Finally, a projection of wind in the UK to 2050 is made.

2. UK ON-SHORE WIND POWER INSTALLATIONS

2.1 Existing installations

The distribution of existing on-shore windfarms in the UK is shown in Figure 2 and Table 1 (red circles), which shows a preponderance of such generation on the western side of the country and, in Scotland, particularly for larger installations

Figure 2 shows the cumulative increase in on-shore wind farm capacity in the UK over the period from 1989 to 2011.

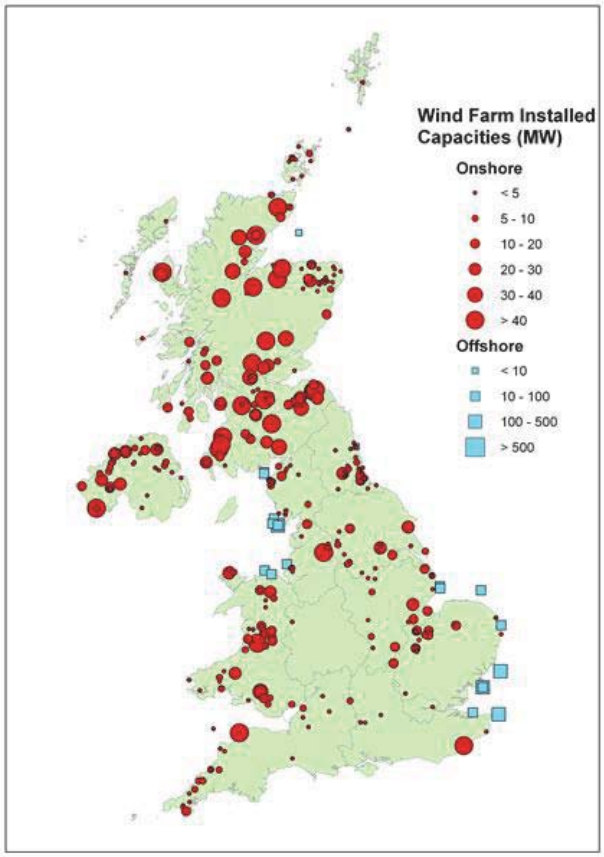

Fig. 3. UK operational wind farms at 2011: Reproduced from [13]

TABLE I
DISTRIBUTION OF INSTALLED ON-SHORE WIND POWER IN THE UK (TO 2011)

Country	Capacity (MW)
England	616
Northern Ireland	306
Scotland	2241
Wales	377
Total for UK	3680

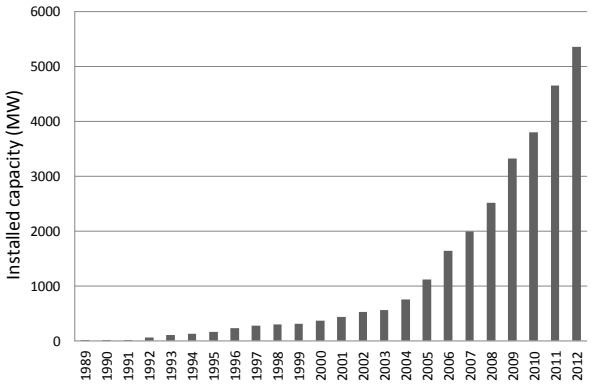

Fig. 2. On-Shore Wind Farm Installed capacity

An estimate of the overall capacity factor (CF) of the UK on-shore wind fleet factor can be calculated using Equation 1;

$$CF = \frac{Annual\ Energy\ production\ (TWhr)}{Total\ installed\ fleet\ capacity\ (MW)*8760} 100 \qquad (1)$$

Energy production values are taken from Figure 1 and capacity data from Figure 2 (Data from 2005 onwards has been omitted to exclude the contribution of off-shore installations). The results from Equation 1 are shown in Figure 4. This estimate of capacity factor is in line with the recorded capacity factor of 27% for on-shore windfarms in the UK from 2005[10]. The use of the entire fleet in capacity factor calculations obscures (i) regional differences (ii) the improvements in wind turbine technology and reliability achieved in the newer installations (longer blades and reduced downtime) and (iii) the decline in capacity factor with age of installation [11]. It is considered that future turbines could achieve rated powers in the range 4-6 MW and capacity factors of up to 50% [12].

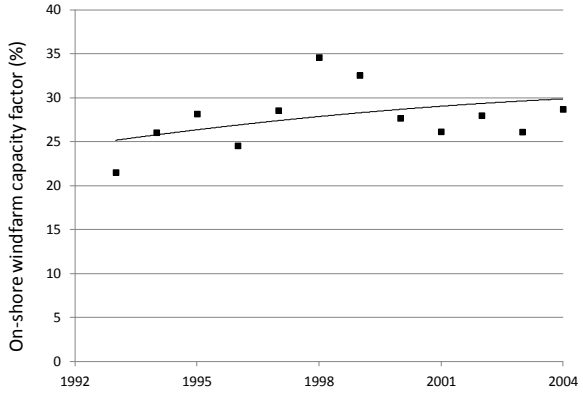

Fig. 4.Capacity factor of UK on-shore wind farms

More details on the individual wind turbine size at all UK on-shore installations from 1989 to 2011 are given in Figure 5. It can be seen that from 1989 to 1999, turbine size was restricted to sub-MW. Since 2000, turbine size has increased significantly with several sites operating with 3MW units. However, there is also continued widespread use of lower-output turbines from 800kW upwards. The number of wind turbines at on-shore windfarms has not grown significantly over the past two decades, and only two operational on-shore wind farms exceed 100 in

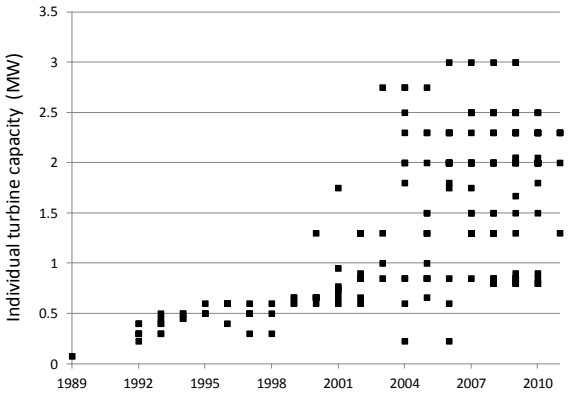

Fig. 5. Individual turbine capacity at on-shore wind farm installations

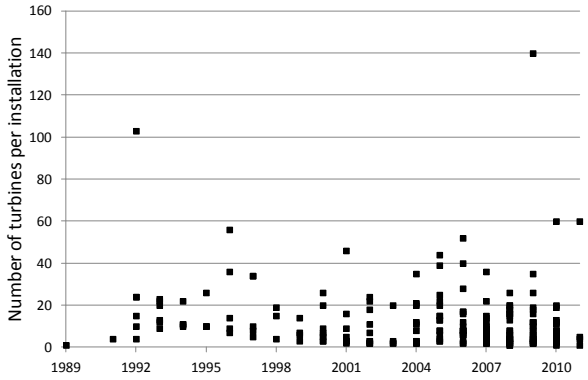

Fig. 6. Numbers of turbines at on-shore wind farm installations

turbine numbers. The first, Llandinam windfarm in Powys, Wales was constructed in 1992 and comprises 103 turbines. This site is currently under application to re-power with a smaller number of larger capacity turbines. The second, Whitelee in Scotland, is Europe's largest onshore windfarm and has 140 turbines and an overall capacity of 322MW. This windfarm has ongoing construction of an additional 75 turbines that will add 217MW capacity to the site [14]. The total capacity of all UK on-shore windfarms is shown in Figure 7.

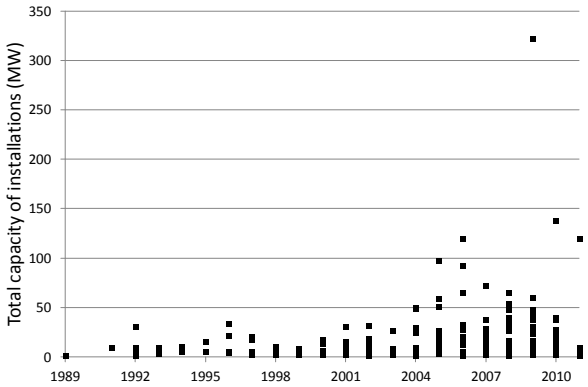

Fig. 7. Total capacity at on-shore wind farm installations

2.2 Proposed on-shore wind installations

Based on the UK Department of Energy and Climate Change planning database [14], the projected installed capacity of UK on-shore wind power is shown in Table II. This shows that an additional 6753MW (a figure in excess of the current operational capacity of 5358MW) has already been approved and is either under construction or awaiting construction. Beyond this, there is another 6.9GW of on-shore wind capacity at the planning application stage. However, the on-shore wind farm planning application process takes up to two years and currently applications on have an approval rate of only 40% [15].

TABLE II
FUTURE UK ON-SHORE WIND POWER

Status	Capacity (MW)	Cumulative UK on-shore capacity (MW)
Operational	5358	5358
Under construction	2323	7681
Pre-construction	4430	12111
Planning application	6909	19019

3. UK OFF-SHORE WIND POWER INSTALLATIONS

3.1 Existing installations

Offshore wind power first received its first incentive under the now obselete 'Non-Fossil Fuel Obligation' (NFFO) which was introduced under Electricity Act 1989 and this led to the establisment of the first relaively small off-shore installation of two 2MW turbines at Blyth in the north of England. The UK government then established with the Crown Estate, the owner of UK coastline out to a distance of 22.2 km, a framework to develop offshore wind farms. Three stages of leases were established, as shown in Figure 8, known as Rounds 1, 2 and 3.

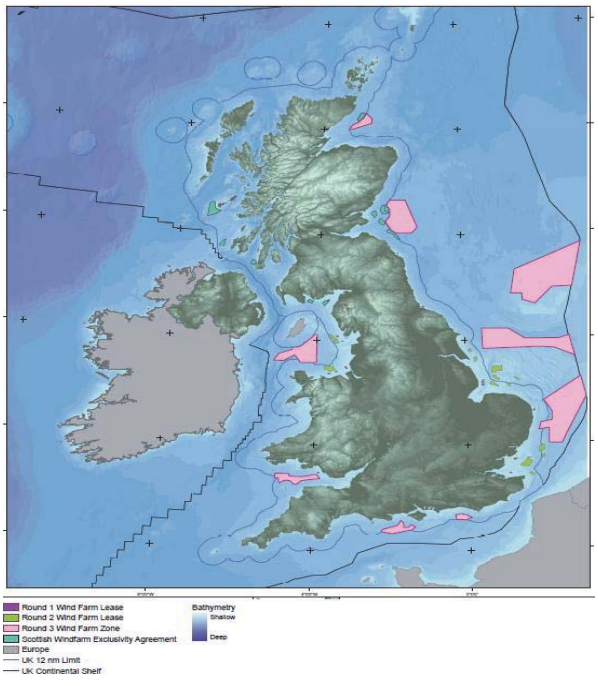

Fig. 8. Details of Round 1-3 on-shore wind farm lease areas (reproduced from [16])

There were 17 developmental projects granted under Round 1 in 2001 with a total capacity of 1.1GW. In December 2003, 15 projects were awarded under Round 2, with a combined power generating capacity of 7.2 GW. The Crown Estate launched a third round of site allocations in June 2008. As can be seen from Figure 8, Round 3 occupies significantly greater areas and, alone, may contribute up to 25 GW.

The increase in off-shore wind installated capacity under Rounds, 1 and 2 is shown in Figure 9, the individual turbine capacities (Figure 10), and the total nubers of turbine units at each installation (Figure 11). Figure 12 shows the total capacity of each wind farm.

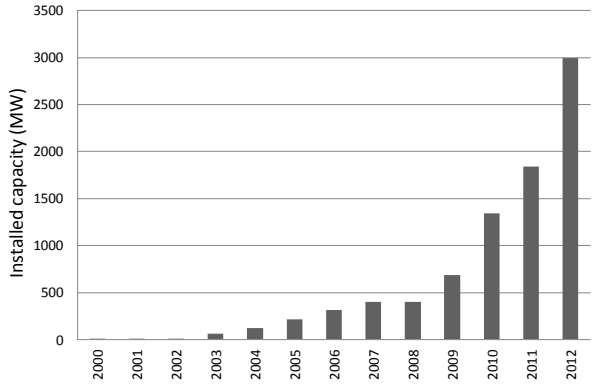

Fig. 9. Off-shore wind farm currently installed capacity

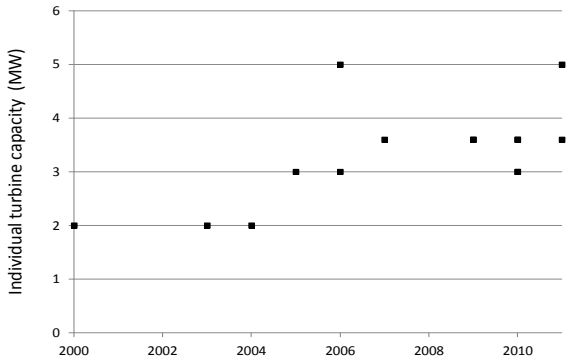

Fig. 10. Individual turbine capacity at off-shore wind farm installations

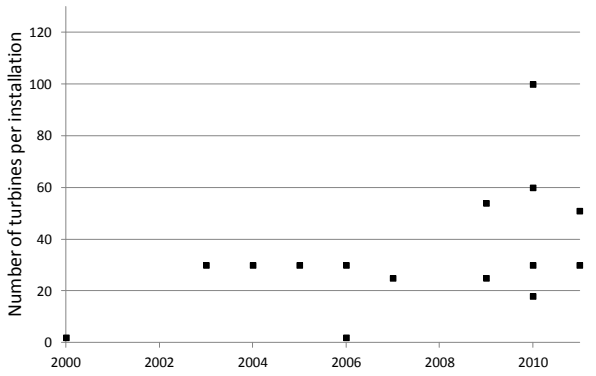

Fig. 11. Numbers of turbines per installation, off-shore

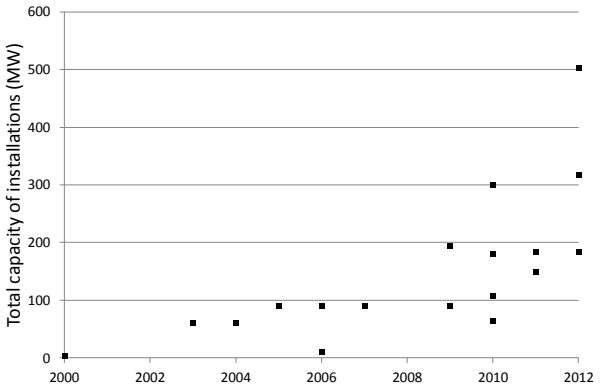

Fig. 12. Total capacity of off-shore wind farm installations

From Figures 9-12, it can be seen that all turbines for off-shore projects are at least 2MW and since 2005 have been between 3 and 5MW. The numbers of turbines per farm for Rounds 1 and 2 range between 20 and 100.

The highest capacity factor for a UK Round 1 off-shore wind farm was 36% in 2006 at North Holye, but other Round 1 farms did not perform so well, with the others having CF values in the range 24.1% to 27.7% [17-18]. Capacity factors are expected to rise for off-shore to 38% 2024 [17]. A detailed analysis of the performance of Round 1 windfarms can be found in [18].

3.2 Proposed off-shore wind installations

From the UK Department of Energy and Climate Change planning database [14], the projected installed capacity of UK off-shore wind power is shown in Table III. This a projected large increase in cumulative capacity. Round 3 and Round 1+2 extensions have not yet progressed beyond the planning application stage. Further applications under Round 3 are envisaged.

TABLE III
PROJECTED UK OFF-SHORE WIND POWER

Status	Round 1	Round 2	Round 3	Capacity (MW)	Cumulative capacity (MW)
Operational	1222	1771	0	2993	2993
Under construction	62	1476	0	1538	4531
Pre-construction	0	1999	18	2017	6548
Planning	(	2095	)	5198	7293	13841

4. ECONOMIC CONSIDERATIONS

British electricity suppliers are required by law to provide a proportion of their sales from renewable sources such as wind power. The supplier receives a Renewables Obligation Certificate (ROC) for each MWhr of electricity purchased [19]. Off-shore wind attracts double the 'ROCs' per MWhr compared with on-shore to reflect the additional costs. Wind energy generation costs were estimated at £83/MWhr (~$150/MWhr) for on-shore and £169/MWhr (~$250/MWhr) for off-shore at 2011 [20]. The premium costs for windpower, as with other renewables that fall under the Renewable Obligation, are ultimately passed on from the electricity suppliers to the electricity consumer as higher per unit charges.

5. WIND GENERATION TO 2020 AND THE ELECTRICITY SYSTEM

5.1 UK electricity system: description of current system and its historical development

The electricity system in the UK includes a 50Hz, 400kV/275kV transmission system which was established in the 1950s-1960s under a nationalised authority, which became the Central Electricity Generating Board (CEGB). This network, known as the 'supergrid', as contructed to meet the rapid growth in UK demand in the decades up to the 1970s (~doubling of demand every decade). The supergrid was overlaid on the previous national transmission grid (operating at 132kV) which was established in the 1930s. Accompanying the supergrid transmission development and also under CEGB ownership, large centralised thermal power stations were established to feed into the new transmission system. The generation was based on coal (mainly) and nuclear power with 660MW standard size generating sets. The new coal-fired power stations were chosen to be sited at the midlands and northern coal fields rather than in the major urban centres, as had been previously the case, due to reasons of transportation efficiency and urban clean-air legislation. Nuclear plant were sited, generally, on the coast and away from centres of population. The function of the supergird was therefore, not only to interconnect the large new generating plant, but also to provide an element of bulk power transfer capability within the UK (mainly from north to south). At its time of design, the supergrid was estimated to have a potential capacity of up to 120GW. With the phased retirement of 132kV generating stations, the 132kV grid network gradually evolved into a distribution-type network in England and Wales and ownership was transferred, subsequntly in the 1970s, from the CEGB to the distribution companies, also at the time under public ownership. The 132kV network in Soctland remains a transmission network. The consequence of the retirement of 132kV-based generation was to lose the ability to control voltage at the main 'bulk supply point' substations feeding the power from the transmission system to the distribution systems. The solution, implemented over many years, was the widespread introduction of shunt capcitive reactive compensation [21].

In 1990, the electricity industry in the UK was privatised, with the formation of one main transmission operator (TO) - National Grid – and, over time, a large number of independent private generating companies were established. The distribution companies companies are now privately-owned 'distribution network operators' (DNOs) while the commercial arrangements for electricity are handled between the generators, companies known as electricity suppliers, and consumers. The Transmission Operator (National Grid) has two main responsibilities (i) to ensure there is an adequate and reliable network to meet anticipated power transmission requirements and (ii) as an operator for the residual power balancing (difference at any given time between contracted generation and required demand). The industry is now market driven and the structure of the market and the conduct of the particpating companies is the responsibility of the an independent regulator (OfGEM). The UK government's Department for Energy and Climate Change (DECC) sets the regulatory framework.

5.2 Impact of windfarms on transmission operation

The exisiting on and off-shore windfarms associated with Rounds 1 and 2 are connected to the UK electiricty networks at voltage levels of 132kV and below. Future larger off-shore farms associated with Round 3 may be required to be connected directly to the transmission system. The voltage level and design of connection for an individual farm will be dependent on its capacity in relation to the local network thermal capacity, voltage regulation and protection requitements. However, given the projected significant increase of wind generation, it is necessary to assess impact on the overall UK transmission network. One of National Grid's future scenarios, know as 'gone green', is shown in Table IV. The transition to 2020 is shown in Figure 13 as a year by year net change in generation type.

TABLE IV
NATIONAL GRID'S 'GONE GREEN' SCENARIO FOR 2020

2010/11	2010/11	2020
Coal	28.2	14.5
Coal (CCS)	0.0	0.6
Nuclear	10.8	11.2
Gas	31.9	34.7
Oil	3.4	0.0
Pumped Storage	2.7	2.7
Wind	3.8	26.8
Interconnectors	3.3	5.8
Hydro	1.1	1.1
Biomass	0.0	1.6
Marine	0.0	1.4
Total	85.3	100.5

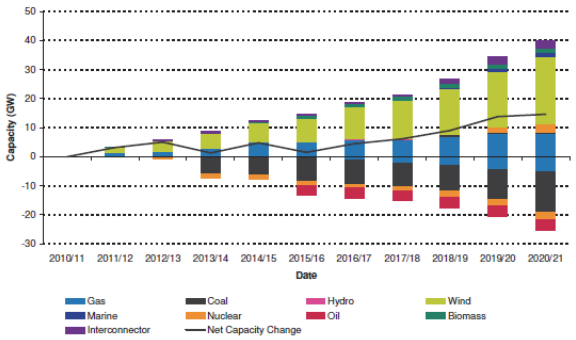

Fig. 13. Net change in GB transmission connected generation capacity: (reproduced from [22])

As can be seen from the table, it is projected that 28% of the transmission connected fleet will consist of wind (and other renewables). Assuming a capacity factor of 30%, 70TWh (20%) of average GB demand (320TWh) will be met through wind compared to 3% currently [22]. This high level of variable generation introduces more uncertainty and challenges for balancing generation and demand as well as requiring new infrastruture capacity. It is expected that there will be a significnat increase in operating reserve requirment on the transmission system. An illustration of the challenge of variability is shown in Figure 14.

The large variability of wind generation is clearly seen, with load factors ranging from almost zero to ~80%. The demand

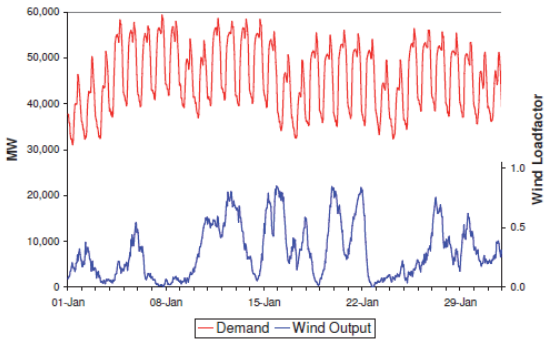

Fig. 14. GB demand and wind generation profile on Jan 2010 (reproduced from [22])

profile has its expected daily shape with lower levels across weekend and holiday periods. National Grid has carried out calculations by scaling this wind profile to 2021 (26.7GW capacity) and subtracting it from the projected total GB demand. Figure 15 represents a likely generation profile that would need to be met by conventional thermal generation.

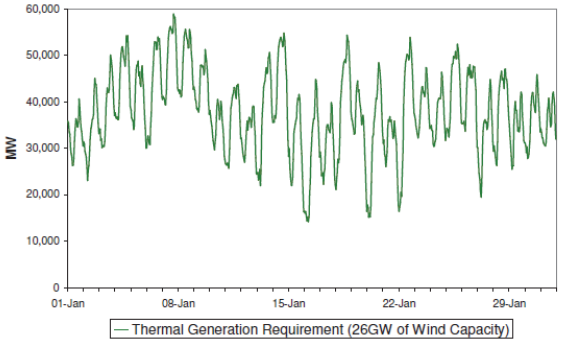

Fig. 15. Example of thermal generation requirement: GB demand net of wind projected to 2021 (reproduced from [22])

5.3 Meeting the challenges

System operation measures

National Grid assume that wind will not generally be curtailed to provide operating reserve except in periods where the sum of inflexible generation plus wind exceeds minimum demand. Therefore, it is expected that flexible thermal plant will meet operating reserve requirements which are made up of

(i) Basic Reserve – reserve for demand forecast error and conventional generation loss

(ii) Reserve for response –sudden loss of 2 times the largest generating set (1800MW)

(iii) Reserve for wind – to manage variability.

A projection of this requirement in 2020 by National Grid is shown in Figure 16.

It should be noted that improved wind forecasting models will also hep to reduce the operating uncertainty. Currently, it is assumed that wind output can deviate from forecast by 50% over 4 hours; the aim, through developing improved forecasting models, is to reduce this to around 30% by 2020. [22].

Increased transmission capacity

Increased capacity of interconnectors to mainland Europe can also help. As can be seen form Table IV, interconnector capacity is projected to rise to 5.8GW which provides potential operating benefits. Agreements between the TSOs either side of the interconnectors (GB and France, Ireland, Netherlands and Belguim) allow for cross border balancing or emergency assistance services for system security.

In the period up to 2020, it is projected that the transmission network will require reinforcements through additional generation connections, transmission upgrades with Quadrature Boosters, HVDC interconnections within the transmission network, series and shunt reactive compensation, further HVDC interconnection to Europe and upgrades to existing transmission circuit capacity (voltage and current upgrading).

Demand side control measures

The increased deployment of smart metering is expected to achieve some flattening of the demand load curve and further opportunities exist with large industrial electrocoty users to achieve significant controlled demand reduction with minimal consumer impact.

Research and developments

The following examples are areas of ongoing research as a result of expected higher levels of wind generation;

Uprating of capacity and voltage of HVDC converters

Multi-terminal HVDC systems

European Supergrid

Higher capacity HV cables

Gas Insulated Lines for AC off-shore transmission using alternative gases to SF6.

5. ELECTRICITY AND WIND GENERATION TO 2050

National Grid has taken the ‘gone green’ scenario and made a projection to 2050, as shown in Figure 17 (based on a reduction in overall greenhouse gas emissions by 2050 of 80% on 1990 levels). Here, electricity demand increases mainly due to the wide-scale introduction of heat pumps and electric vehicles and rises to ~500TWh per auum 2050. Electricity supply is predominantly low-carbon by 2030 with extensive wind generation. Beyond 2030, wind is considered mature and its capacity levels out, while nuclear is set to rise alongside Carbon Capture and Storage (CCS) power stations fuelled by coal, biomass and gas. It is anticipated that there will be no unabated thermal generation by 2050 [23].

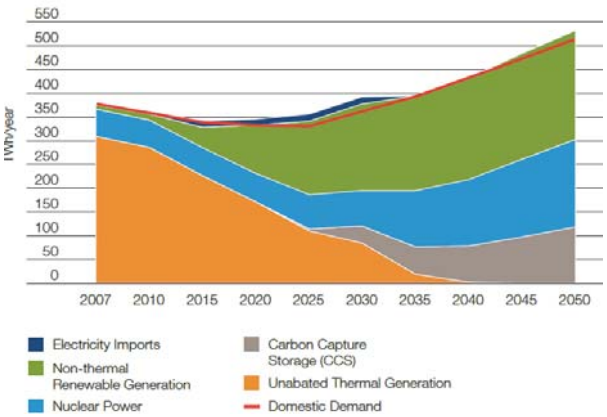

Fig. 17. Electricity demand and generation projected to 2050 (reproduced from [23])

5. CONCLUSIONS

The UK has made progress to install significant quantities of on-shore wind installations and is currently the world leader for off-shore projects. The currently installed capacity of 8GW may ramp up to 27GW as soon as 2020. Considerable transmission network infrastructure reinforcement will be required to accommodate such large quantities of wind power and there will also be significant operational challenges to maintain sufficient operating reserve. As far forward as 2050, wind may be seen as the largest of three main electricity resources alongside nuclear and CCS conventional carbon fuel generations.

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ENERGY POLICY AND INFRASTRUCTURES IN FINLAND

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Presentation at Doshisha University
March 2013

ENERGY POLICY

Being an EU member state, the energy policy of Finland is very much influenced by the EU directives and policy. According to the EU Energy Package 1/2007, the following developments must be realized by the year 2020 on EU level:

- Cut 20% of greenhouse gas emission
- Increase 20% of renewable energy
- Increase 20% of energy efficiency

The targets have been divided between the member states according to their capabilities and starting level. Finland being intensive in bio fuels has the target of renewable power production to be 38% of energy production. Another important piece of legislation is the EU Energy Efficiency Directive 2006 which has been implemented by energy efficiency audits and agreements, and by an act requiring by 2013 hourly metering for practically all the customers.

Other instruments of energy policy include in-feed tariffs for renewable production, where the state is directly subsidizing for 12 years for plants over 500 kW.

In the future the emission trade will have more impact, since the price of the emission rights is expected to rise. A perhaps unexpected byproduct of emission trade has been so called wind fall profits. These are created using CO_2-free production, like nuclear and hydro, since the market price of power is increased due to the emission trade. There is a discussion whether these wind fall profits should be taxed.

The Nordic power generation system is depicted in slide 3. The dominating generation is hydro with about 50% share. The other two large generation categories are nuclear and CHP (combined heat and power). For peak power production some condensing conventional and gas turbines are used.

In Nordic countries the power price level is mainly set in spot market, in the Nordic level. The system price is simply defined by summing the hourly offers to buy in decaying price order, and offers to sell in rising price order. The point where these sum curves intersect defines the system price for all the spot power of the respective hour. In practice this means that the more the actual generation cost is below the marginal generation price of the hour, the bigger is the profit made by the generation company (slide 4).

Though being a part of Nordic power market, the price area depends on the transmission situation and load flows in the interconnecting lines. Finland has interconnections with Sweden over AC lines in the North and a submarine DC cable link through the Baltic sea. To the Estonia there is also a DC submarine cable, and to the Russia an AC/DC – DC/AC link, capable of transmitting 1400 MW. A typical transmission situation in winter time is shown in slide 5.

INFRASTRUCTURES

The basic power system structure in Finland is presented in slide 7. The main part of the transmission network is operating at 400 kV with some older parts at 220 kV. These networks are of bare conductor overhead line construction. Local subtransmission operates at 110 kV. At this level the tendency is to use more underground cables in the city and suburban areas. The distribution is operating mostly at 20 kV voltage, with the exception being the urban core in some old cities like Helsinki and Turku, where 10 kV is used. And finally, the low voltage is the standard 0.4 kV system.

The Nordic transmission system is shown in slide 8. The tendency is to build new tie lines to Central Europe, which in practice means that the Norwegian hydro capacity will be used in higher degree to level the intermittent renewable production of Germany, for instance. The price formation in the Nordic power market depends on the generation situation versus the tie line capacities use. In case of restriction in tie lines, the Nordic area is divided into price zones, however Finland is operating practically as a single uniform price area. As is seen in slide 9, the price differences in the areas typically are small. This is however, expected to change in the future when the market is getting stronger coupling to Germany and other Central Europe.

The division of the power generation or supply types in Finland is shown in slide 10. The dominating types are Nuclear, CHP, hydro and imports. CHP is mostly used in larger cities as the main heating system (with regard to the building volume) is district heating. About 120 companies are involved in generation, the biggest being the power companies Fortum (40%) and PVO Group (20%), slide 11.

The energy and power demand and their expected growth are depicted in the slides 12 and 13. It is expected that though the energy efficiency will be increased, the power demand is still growing due to the fact that many energy efficiency investments, like heat pumps and electrical vehicles, decrease the use of fossil fuels but require the increased use of electricity.

The division of power consumption among sectors is shown in slide 14. Industry uses rough half of the power, households 22%, service 12% and public sector 7%. The high share of households is explained by intensive use of electricity for space heating.

The power market in Finland was liberalized in 1995. The basic rule is that selling and generation is governed by the markets, whereas transmission and distribution networks remain monopolies and thus must be regulated. The Transmission System Operator Fingrid is responsible for technical and commercial balance management and is not allowed to participate in energy trade as an active party. The networks are unbundled from generation and selling in

order to prevent cross-subsidizing which may distort the markets. The principal operation of power markets is illustrated in slide 17. Although the power price is set at Nordpool, there also are bilateral agreements between major parties, i.e. producers-retailers, producers-large end users etc. The prices in power exchange are published but the bilateral agreements naturally are not.

The operation of the power market from the power balance management point of view is presented in slide 18. The Nordic spot market has two products, Elspot being the hourly market for the next day, and Elbas being the hourly intraday market. In addition there is regulation power market for next hour balancing, operated by TSO Fingrid. The prices are set differently for the three cases: generation up, generation down and leveling the demand (demand up is equal to demand down). The purpose of this regulating market is to optimize the immediate balance of generation and demand at the hour of delivery. So far the price of the regulation power has been relatively close to the price of power in spot market, thus indicating that the market is working well and that there are no problems with the control or peak power capacity.

Distribution networks

The following section gives an outline of the distribution network infrastructure in Finland. A brief history of the power system development is in slide 20. The power systems were first introduced in some factories and as local systems to replace the gas based street lighting in some major cities. This happened in 1880´s. The city utilities were mostly established round the beginning of the 20th Century, but the largest rural networks were built only after the World War II, in the late 1940´s. The rural power companies were slowly merged as bigger units, but no major changes happened in the industry until in 1995, when the power markets were liberalized.

The two major steps in power market development were in 1998 when all customers were allowed to freely choose their power producer and in 2013 when all customers are to be taken to the hourly based automatic meter reading. This latest step is expected to be crucial for the development of energy efficiency. In addition to the remote reading the hourly demands on a daily basis, the meters are equipped with remote control capability that makes the control of e.g. heating loads possible, thus enabling Demand Response.

Characteristic for the Finnish distribution system is long distances, sparse population, demanding climate and relatively high electricity use per capita (slide 21). There are around 130 000 km of medium voltage lines to supply 5.4 million people, or about 2 million electrical customers. The lines are primarily of overhead construction, and built straight through forested areas which makes them vulnerable to disturbances caused by strong winds, snow and lightning. An example of the network layout in a rural area is given in slide 23. Most of the primary substations do have a double feed from the 110 kV subtransmission network, but some of the HV/MV stations are of satellite type, that is, they only have one supplying line. In these cases the only reserve supply is over MV network. The medium voltage network has a similar layout, with some parts being in loop and some secondary substations only having one feeding MV line. In case of loop, the operation is however radial and the reserve supply requires time consuming switching.

The large distances and relatively small load density mean strict financial limitations to the basic solutions of the power delivery systems. Consequently, the networks are relatively simple. Examples of the typical primary (HV/MV) substations in rural and suburban areas are given in slides 26 and 27. An example of the MV switchgear building is given in slide 28, and a typical case of the present type MV overhead line is given in slide 29. Being a forested country, the poles of the overhead line are made of wood. The lines were built in time when materials were expensive, but the labor was cheaper than nowadays. That is why the lines are built short and straight and, in most cases unfortunately, through the forests. Nowadays the new lines are built primarily along the roads for two reasons: they are easier to patrol and repair and also exhibit lower fault rates since one side of the line is in open air. Since the strongest winds come from west, the lines are preferably located on the eastern side of the road.

Improved supply reliability is also looked for by using insulated overhead line structures. Very popular is the covered conductor line, where the phase conductors of the line do have a thin insulation layer. This insulation is partial, but good enough to prevent supply interruptions in case of temporary touching of phases with each other or with ground. At the time being the rural underground cabling is in focus too. Some rural distribution companies have an active policy towards underground systems, but others are hesitating due to the high costs of civil works. In Finland, the dominating soil type is moraine, making the ground works tedious.

A typical secondary substation in rural areas is shown in slide 31. Traditionally, the distribution transformers in rural areas have been pole mounted, but the current tendency is to locate them in cabins on the ground level, regardless the type of the connected lines. In low voltage networks the dominating line type (in rural areas) has been an Air Bundle Cable as shown in slide 32. However, nowadays practically all new LV lines are built using underground cable, installed in many cases by plowing.

The comparison of overhead line and underground line costs is shown in slide 34. It is seen that the higher is the voltage the relatively more expensive is the underground cable. Cabling will first come to lower voltages and to more densely populated areas.

With regard to overhead line structures, some pole and tower types used are shown in slide 35. In 400 kV level, the towers are solely metallic, but at 110 kV both metal and wood are being used. In case of wood the preservative is creosote for 110 kV towers, but for wood poles at MV and LV level, CCA-impregnation (copper-chrome-arsenic) was previously used. The latter is nowadays regarded as harmful for environment and hence it has been replaced by copper-impregnation, which unfortunately is not as effective.

A detailed figure of a CC-line is given in slide 36. For the case of lightning, the line must be equipped with arc protection, implemented as metallic arcing horns at every phase and every insulator. In addition to the reduced interruptions of supply, the benefit of using CC-line instead of bare conductor overhead line, is the narrower right of way needed. A more detailed figure of the LV ABC-line is given in slide 38. The messenger of the line is also working as a neural wire. This leads sometimes during the storms to a dangerous situation with over voltages at the customer side, if the messenger is broken. The risk can be mitigated by suspending the messenger using a mechanical fuse link, which yields prior the messenger is broken.

A comparison of the limiting factors with regard to the rating of overhead lines versus the cables is given in slide 39. As seen in the figures, the load capacity of the overhead lines is primarily limited by the voltage drop, whereas the capacity of cables is restricted by the thermal limits (ampacity limits).

An example of the typical MV power cables used in Finland nowadays is shown in slide 40. The new cables have XLPE-insulation (cross-linked polyethylene), and they have water sealing in both radial and axial direction. If no water sealing, the water treeing phenomenon would destroy the cable insulation before the technical life time would be otherwise to the end.

Increasing the reliability of power supply is in the focus, since the society is getting more and more dependent on the uninterrupted power. Supply reliability is still a subject of optimization since it requires quite large investments from the power company´s side. The optimum level of reliability investments should be defined by the trade-off between the utility´s investments and the reduction of the customer´s outage costs, slide 43. Nowadays, the reliability of distribution systems is monitored by the authorities and the key indexes of the outages are collected and compared. Some internationally accepted reliability indexes are listed in slide 44. There is a number of options, which may be used in order to increase the supply reliability level:

- New HV / MV substations
- New feeders
- New reserve connections
- Network protection
- Operational arrangements
- Network automation
- Replacement strategies
- Maintenance strategies

Nowadays the quality of service that the power companies are offering to their customers is also getting more attention. Broadly speaking, the quality of service covers the information services delivered to the customers and the power quality (PQ), which is in turn divided into interruptions of supply and voltage quality. Voltage quality is getting more of interest since on one hand the sensitive equipment are getting more common, and on the other hand, there is development of connecting more power electronics in the networks, with the consequence higher emissions of disturbances, slide 49.

According to the regulation, the longer outages have now been penalized in Finland. In case of excessive outage times, the power companies are obliged to give to the customer concerned a substantial discount of the power price, slide 50. When increasing the reliability of power distribution systems, it is necessary to know better the causes of faults and outages in power systems. For Finnish rural MV networks, these are listed in slide 51, based on the statistics of the Energy Industry Association. Major part of faults is covered by natural phenomena, storm and wind, snow burden on lines or trees and lightning.

FUTURE CHALLENGES OF POWER SYSTEMS IN FINLAND

Certainly the biggest challenge of our society and also power systems is the climate change. From generation point of view this means an urgent need to cut CO_2-emissions and to shift to renewable energy sources. From power transmission and distribution point of view, the climate change will amplify the extreme weather conditions and hence endanger the security and reliability of the power system. The most important weather factors that affect the power system and that will be amplified are wind, thunder, snow and a tree fallen by snow (affected by the lessened frost in the soil). The changes in these factors, for two different scenarios and in the North-West coast of Finland are depicted in slide 53. The scenario 1 refers to 0.5 degrees increase in average temperature and the scenario 2 refers to 1.5 degrees respectively. It is seen that the climate change will perhaps drastically increase the reliability problems in present power systems.

Examples of the real cases where weather has caused trouble to infrastructures are shown in slides from 54 to 57. In slide 54, the impact of a storm called “Gudrun” in South Sweden, in January 2005, is shown. The storm destroyed 20000 km of MV line and caused a sustained outage to 340 000 households for several days. After the storm, 6000 km of underground cables were laid in a quick pace.

The second example is crown snow (slide 55). The formation of it depends on the behavior of temperature and snow fall around zero degrees temperature. In a typical case, large areas at the same altitude level are affected by the crown snow formation, causing extra mechanical stress to the line constructions and felling trees on the phases. The problem may be sustaining for a period of several weeks. Even worse is the ice storm where icing of the mechanical structures is combined to the strong winds. In Canada, in January 1998, over 4 million people lost electricity due to the ice storm, slide 56.

The extreme weathers will also make lightning more common and stronger. In the future, the role of lightning protection will be increased in the power systems. Especially in the case with extensive use of cables, the management and protection of lightning overvoltages is a crucial issue, since the cables are more vulnerable to overvoltage failures than the overhead lines.

Energy policy and infrastructure in Iceland

Unnur Stella Gudmundsdottir

***Abstract*— This paper describes the energy policy and infrastructure in Iceland. Iceland is a geographically isolated island, placed in the North Atlantic. This country, having the highest power consumption of the world, has achieved 100% power production from renewable energy sources. The country is rich in hydro and geothermal resources, which have been harnessed for electricity production and household heating systems. Furthermore, Iceland is in front when it comes to hydrogen powered vehicles, having 40 public busses, powered by hydrogen, produced using renewable energy.**

***Keywords*: Iceland, Renewable Energy, Energy Policy, Infrastructure**

I. Introduction

ICELAND is a country with a small population, only 320,000 people living on an island of 103,000 km^2. In comparison, Japan is 3.5 times larger in area but has over 127 million people (almost 400 times the number of people in Iceland). Nevertheless, Iceland is a country having one of the largest consumption of energy per capita, in the world, 28.2 MW/year (Japans consumption is approximately 5.19 MW/year per capita).

Iceland is a volcanic island placed in the North Atlantic. The island is both in North America and Europe, as the separation of the two plates runs through the middle of the island. Politically, Iceland is a part of Europe, although not a member of the European Union.

Fig. 1 The world map. Iceland is placed in the North Atlantic, marked with a red circle.

The landscape of the island is quite harsh, as only the coastline can be used for living. This is due to the fact, that the rest of the island is filled with volcanos, large mountains and numerous glaciers. Furthermore, almost 60% of the population lives in or near Reykjavík, the capital of Iceland.

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Fig. 2 Iceland is an island filled with volcanos, mountains and glaciers.

The rough landscape is also what forms the standard of living in the country, and the possibilities in energy usage. Due to the volcanic activity and mountains with large glacier rives, there are numerous geothermal areas and sources for hydropower. Therefore, as the only country in the world, 100% of energy production in Iceland is from renewable energy sources. 77% of total capacity is produced by hydro plants, while 23% is geothermal energy. Furthermore almost 90% of all space heating comes from geothermal resources, and the rest is from renewable electricity. Of all power consumption in Iceland, 70% is from renewable sources, while the remaining 30% are imported fossil fuels for vehicles, vessels and some industrial processes.

II. Energy Policy

A large part of the growth in Iceland is due to access to cheap renewable energy sources. The country does not possess hard metals, fossil fuels or areas of rich agriculture, but instead renewable energy is harvested and offered as a cheap sustainable natural resource for power intensive industries. This is the cornerstone for ensuring a sustainable future for the country's economy and one of the main reasons for the fast recovery from the financial crisis that hit Iceland in 2008.

One of the goals of the Icelandic government has been to achieve 100% of all power consumption in Iceland to be from renewable energy sources. It has long been a dream to turn Iceland into the first hydrogen society by 2050, and hence there has been large work done in this field. In 1998 the Icelandic Parliament decided to strive for converting vehicle and fishing fleets to hydrogen, produced from renewable energy. In 2003 the first hydrogen fuel station was opened in Reykjavík and since 2007 there have been 40 hydrogen powered public busses on the streets of Reykjavík. Although the country is in front regarding hydrogen based public transportation, Iceland has seen the possibilities of using electric vehicles instead, due to more efficiency and less cost. The goal is still to become energy-independent, using 100% renewable energy in all sectors, by 2050.

III. Energy production and consumption

Today, 100% of all energy production is renewable and 70% of all power consumption (including vehicles and fleet) comes from renewable energy sources. The largest consumption is by power intensive industry, such as aluminium smelters, green houses and fishing industry. In fact 82% of all produced energy in Iceland (16.5 GWh), is for power intensive industries.

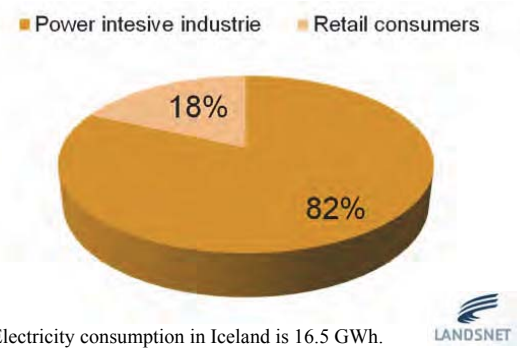

Fig. 3 Electricity consumption in Iceland is 16.5 GWh.

A. Hydro

In 1904 the first hydroplant was set in operation in Iceland. The turbine was 9 kW and was placed in a small town close to Reykjavik, called Hafnarfjörður. In 1915, several small turbines had been started throughout the country, producing a total of 370 kW. In 1965 the official Icelandic electrical production company, Landsvirkjun was established. Landsvirkjun is still today the owner of the largest hydroplants in the country, and the main supplier of electricity for power intensive industry.

Fig. 4 Hydro power plant, Hrauneyjafossstöð, owned by Landsvirkjun.

Today, there are several hydroplants in operation in Iceland. Amongst these are:

- Blöndustöð can produce 910 GWh/year. It was built in 1991 and uses water from a large glacier river in the north of the country. The height difference used for production in this plant is 287 m.
- Búrfellsstöð can produce 2300 GWh/year. It was built in 1969 and enlarged in 1998. The plant uses a large glacier river in the southern part of the country. The used height difference is 115 m, and there are 6 Francis turbines.
- Fljótsdalsstöð can produce 4800 GWh/year. It was built in 2007 and uses water from a reservoir high on the mountains in the east part of the country. The used total height difference is more than 600 m, and there are 6 large Francis turbines in use. From the plant, the water is put into a large glacier river.
- Hrauneyjafossstöð can produce 1300 GWh/year. It was built in 1981 and uses water from a small river in the southern part of the country, 1.5 km above a waterfall and 7 km below another hydroplant. The used height difference is only 88m.
- Írafossstöð can produce 236 GWh/year. It was built in 1953 and enlarged in 1963. The plant uses two waterfalls in the southern part of the country.
- Laxárstöð I can produce 3 GWh/year. It was built in 1939 and enlarged in 1944. The plant uses a waterfall in the northern part of the country.
- Lasárstöð II can prduce 78 GHw/year. It was built in 1953 and uses a small river in the northern part of the country.
- Laxárstöð III can produce 92 GWh/year. It was built in 1973 and uses a small river in the northern part of the country.
- Ljósafossstöð can produce 105 GWh/year. It was built in 1937 and enlarged in 1944. It uses a waterfall in the western part of the country, close to Reykjavik.
- Sigöldustöð can produce 920 GWh/year. It was built in 1978 and taps water from a large glacier river in the southern part of the highlands of Iceland. It contains 3 Francis turbines.
- Steingrímsstöð can produce 122 GWh/year. It was built in 1959 and uses a small river in the southern part of the country. It is a part of three plants after each other in this river.
- Sultartangastöð can produce 1020 GWh/year. It was built in 1999 and uses water from a large glacier river in the south-western part of the highlands.
- Vatnsfellsstöð can produce 490 GWh/year. It was built in 2001 and uses a river from a large lake in the southern part of Iceland.
- Andakílsárstöð can produce 25 GWh/year. It was built in 1942 and is placed in western Iceland, not far north of Reykjavik.
- Elliðaárstöð can produce 16 GWh/year. It was built in 1921 and enlarged in 1933. It is placed in Reykjavik and uses a small river that flows in the city.
- Mjólkárvirkjun can produce 42 GWh/year. It was built in 1975, is placed in the far western part of the country and uses a large glacier river in the area.

Most hydroplants in Iceland use vertical Francis turbines, where the water is taken from a reservoir, through a tunnel and then turns the blades of the turbine.

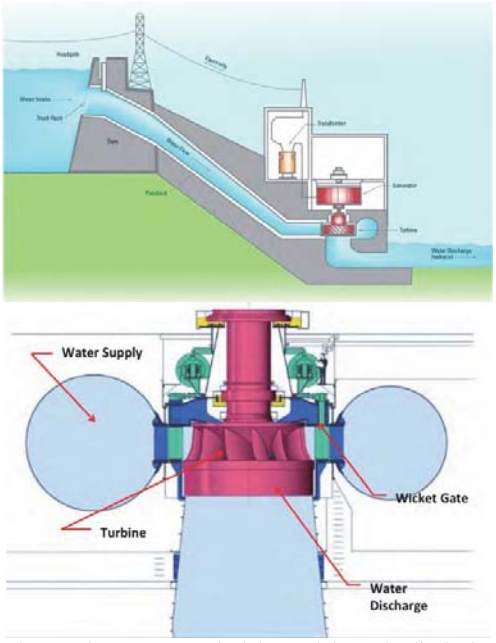

Fig. 5 Above: The common principle used in Icelandic hydro plants. Below: The Francis turbine.

B. Geothermal

Iceland is placed on the Atlantic ridge, where the North American and European plates meet. Due to this, there are large high temperature geothermal fields through the middle of the country, see Fig. 6.

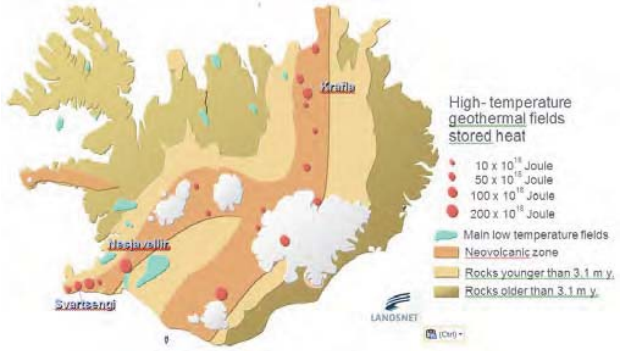

Fig. 6 A high-temperature geothermal field runs through the middle of Iceland.

Use of geothermal resources is split into two categories; using steam from geothermal sources, for producing electricity, and direct use of the geothermal hot water, for household heating, swimming pools, bathing, green houses, etc. In 1907, geothermal sources were first harnessed in Iceland. A farmer put a pipe from a hot spring that led steam into his house using it for his heating system. In 1940-1975, Iceland converted from oil to geothermal district heating. Today, 89% of all houses in Iceland are heated using geothermal energy (the rest coming from renewable electric heating), and 23% of all produced electricity comes for geothermal resources.

For heating houses in Reykjavík and surroundings, a 23 km long pipe is used to transport hot water from two geothermal plants just North-East of Reykjavík, see Fig. 7. Here hot water is pumped at 177 m above sea level, and transported to storage at 140 m above sea level.

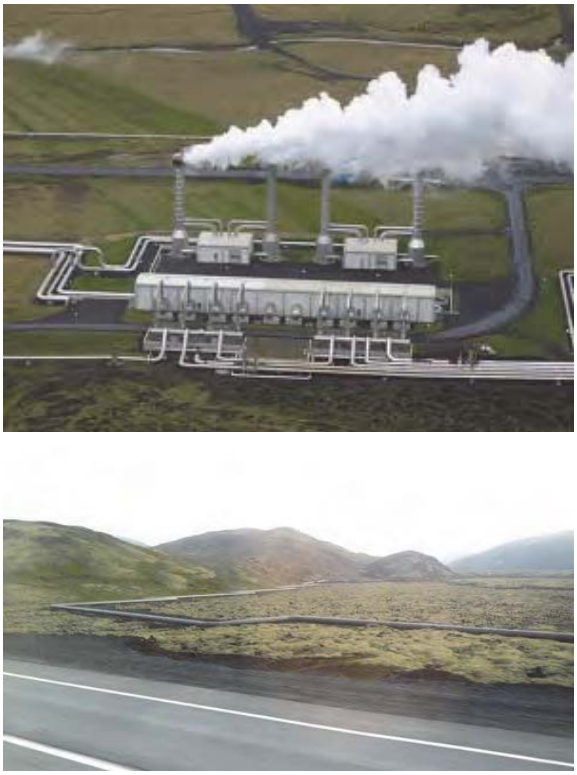

Fig. 7 Above: Geothermal plant at Nesjavellir. Below: Part of 23 km pipe for hot water, from Nesjavellir to Reykjavík.

Most geothermal power plants either produce electricity or heating. There are though few that produce both, as shown in Fig. 8.

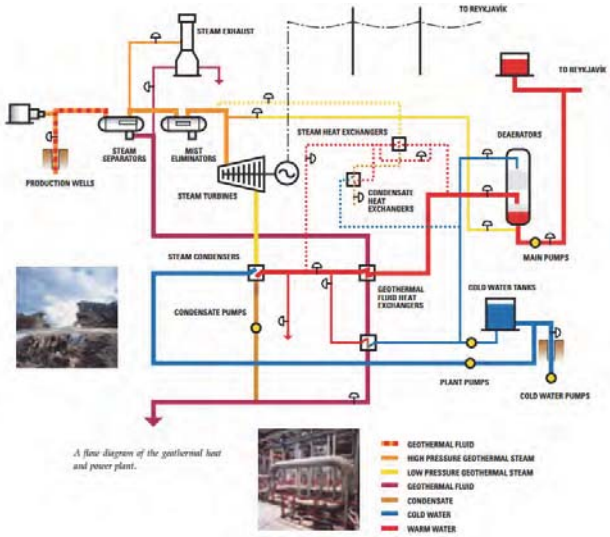

Fig. 8 Principle in a geothermal plant, where both electricity and heating is produced.

The largest geothermal power plants in Iceland are following:

- Nesjavellir can produce 120 MW of electricity and 300 MWt hot water. The plant was commenced in 1990.
- Reykjanes can produce 100 MW of electricity. The plant was commenced in 2006.

- Hellisheiði can produce 303 MW of electricity and 133 MWt of hot water. The plant was commenced in 2006.
- Krafla can produce 60 MW of electricity. The plant was commencend in 1977.
- Svartsengi can produce 76,5 MW of electricity and 80 MWt of hot water. The plant was commenced in 1976. The surplus mineral-rich water from this plant is the very popular and famous bathing resort, the Blue Lagoon.

C. Wind

Due to the privilege of being able to harness abundant low-cost geothermal and hydropower energy, it has not been beneficial to utilize wind as a renewable energy source in Iceland. However, with all its highlands, and placed in the North Atlantic, Iceland is a windy country and having high potential of utilizing wind farms for electricity production.

Iceland has started research in the area of using wind energy, by building two wind turbines. The wind turbines are placed in the highlands, on a flatland between large mountains, forming a natural wind tunnel. The wind turbines were commenced the 14th of February 2013, and each turbine can produce 900 kW. If the research project gives promising results, it is possible to install several more wind turbines in the area.

D. Solar power

Iceland is an island positioned far up in the North Atlantic. Due to the latitude, the country has a relatively low insolation, with very little in the winter. In fact, during November, December and January, the average sun hours a day is less than 1. Therefore, already having 100% electrical production via geothermal and hydro resources, it is not feasible to install solar power in Iceland.

IV. Energy Transmission

The transmission system in Iceland is defined with 3 voltage levels; 66 kV, 132 kV and 220 kV, see Fig. 9. Most of the transmission system is radial, due to the low population, which is scattered on the coastline around the whole island. It is therefore due to historical reasons, that 66 kV is a part of the transmission system, and not the distribution system.

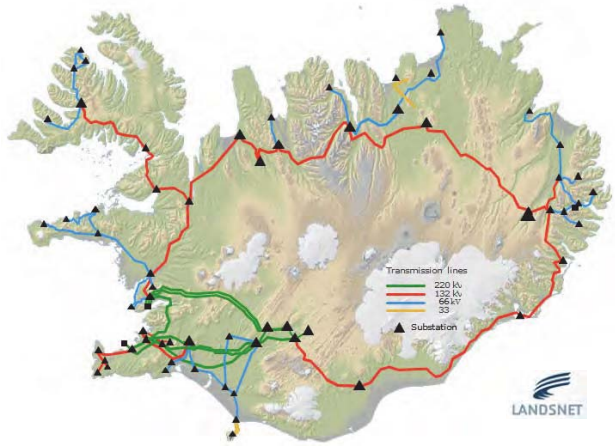

Fig. 9 The transmission system in Iceland in 2012

The total length of the Icelandic transmission system in 2013 is 3170 km. The system consists of a single ring connection, and large amount of radial connections without any connection to other countries. The islands network system is therefore weak and vulnerable for any types of disturbances. Due to increasing demand and larger loads, it is necessary to strengthen the grid network in Iceland. The plan is therefore to build a line, across the island, thus creating more meshed network, to give stability and ensure supply of electricity to both households and industry. Even more strengthening of lines will be built, and the network in 2025 should be 3980 km long, see Fig. 10.

Fig. 10 Plans for network development until 2025.

When building new transmission lines, all environmental aspects must be accounted for. The project needs permissions from the local government, which sets high ambitions for environmental impact and public acceptance. Due to large protest against new overhead lines and focus on the environment, Landsnet, the Icelandic Transmission System Operator, made in 2008 a competition for ideas on new pylons. Some of the outcome is shown in Fig. 11.

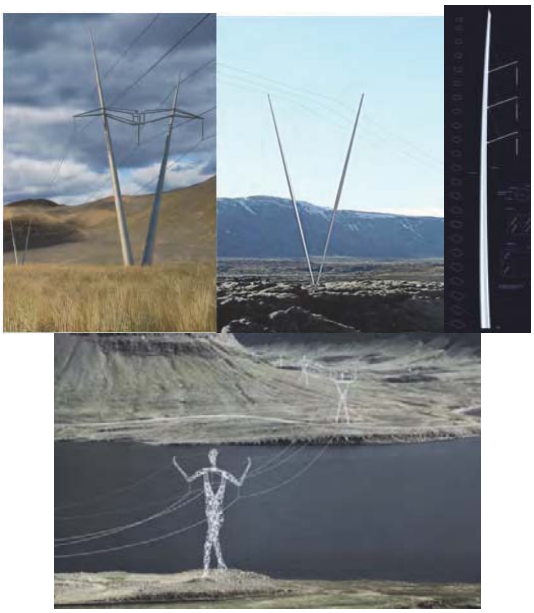

Fig. 11 Ideas for new pylons, results from a competition held in 2008.

The focus has also been on improving the environmental impact of substations. Therefore Landsnet has also looked at some new ideas for indoor GIS transformerstations, shown in Fig. 12.

Fig. 12 Design for indoor transformer stations.

Transmission cables are not common in the Icelandic transmission network. Underground cables are though used in all towns and cities, as well as between the mainland of Iceland and small islands not far from the coastline. In cities, all transmission, water, electricity, telephone lines, fiberoptic network, etc. are kept underground, while in more rural areas, overhead lines are used.

Underground cables are though becoming of more interest amongst the population, and the government has of 2012 established a group of people, looking into possibilities and cost of using more cables instead of overhead lines for transmission of electricity. The results from this group are not available yet, but it is for sure, that high ground heat because of geothermal resources, lava ground and rocky environment, as well as the number of local earthquakes, is a large challenge for the idea of using only, or mainly, underground cables instead of overhead lines.

V. Connection to Europe

It is believed, that there is about 20 TWh per year of unharnessed geothermal energy in Iceland. Furthermore, there is around 30 TWh per year of unharnessed feasible hydropower. This is about 8% of the entire, by year, electricity consumed in Germany.

Due to this high potential for renewable energy sources in Iceland, an electrical connection to Europe has been discussed in Iceland for about 60 years. This has however not been feasible before, but because of increased demand for green energy supply in Europe, and better HVDC and Submarine Cable technology, the voices for an electrical connection to the mainland have been getting more and more interest.

For a connection to Europe, there are three main possibilities; connections to the Netherlands via Scotland, directly to Germany, or directly to Norway, see Fig. 13.

Fig. 13 Possible HVDC connections to the mainland of Europe.

Some research and discussions have been started, but a final decision to the matter has not been made. The project is highly criticized because of the risk of high increase in prices of electricity in Iceland, due to open markets in Europe.

VI. Electricity Market

As of July 1st 2003, there has been an open electricity market in Iceland. Before this date, almost all electricity was supplied by Landsvirkjun, and sold through regional distribution companies. Landsvirkjun therefore at that time, had a monopoly position. Today, the market is split up into three factors: Power intensive industry, losses and general market, see Fig. 14.

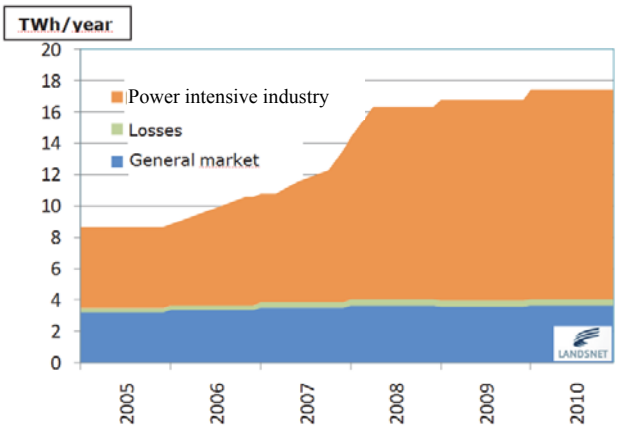

Fig. 14 The electricity market in Iceland.

Due to the fact that Landsvirkjun owns and operates the largest hydroplants in the country, it is the largest or only supplier of electricity to the market for power intensive industries. Furthermore, Landsvirkjun often supplies the minimum stable load, while other smaller suppliers (mostly having geothermal energy plants) deliver power for swings in the load. These smaller companies are also the largest on the general market.

As the rest of the world, Iceland is looking more and more into a future of possible smart grid solutions. The TSO (Landsnet) has therefore a vision, of how the electricity market should be in the future, see Fig. 15.

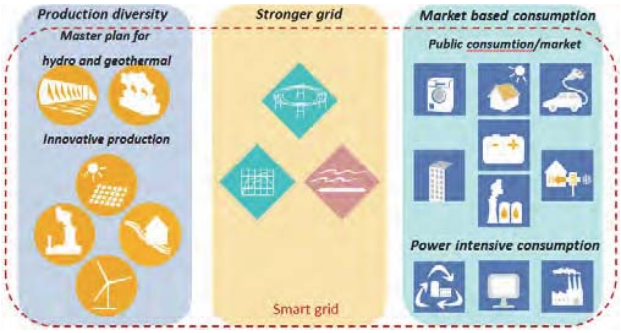

Fig. 15 A vision of the future electricity market in Iceland, borrowed from Landsnet.

For the new market structure, the market should be more open, than it is today. The end-user should have more influence on where to buy the electricity from, and what type of electricity to buy. But due to the fact that the Icelandic electricity market is geographically isolated, this change in market structure is very costly.

VII. Other Infrastructure

Iceland is an isolated country, with small population and has 100% of all electrical production in renewable energy sources. The heating of houses is either done by geothermal hot water, or by electricity from renewable energy supply. And even though the electricity and water consumption is the highest in the world (per capita), and steadily increasing, it is estimated, that there is about 50 TWh/year unharnessed feasible renewable sources in the country. Due to this, there has been no need for either gas or electricity from fossil fuels. Gas has not been harnessed in Iceland, and it is unlikely that there is much of it in the subsea ground around the country. Even though there was, there is no focus and little interest in using gas for electricity or households in Iceland. The only large pipe-system in the country is therefore used for hot water, coming from geothermal sources, or for cold water, coming from the ground or the mountains in Iceland. Clean water is another source in Iceland, where there is no use for water cleaning units or water stations. The water is pumped directly from the ground, where it has been naturally filtered in the rocky landscape. This water is one of the cleanest in the world, and is exported on bottles, to countries with less clean water supplies.

Transportation in Iceland is by vehicles, shipping or airplanes. Due to the low population, railways have not been chosen as a feasible solution, and hence there are no rails in the country. Most cargo is shipped on sea, while some is shipped in air. Import to Iceland is also both by air and shipping.

VIII. Conclusions

This paper has given an overview of the energy policy and infrastructure in Iceland.

The paper explains the energy consumption, power transportation, plans for the future, and other infrastructures in Iceland. It is shown, how even though Iceland has the world record in power consumption per capita, all power production is from 100% renewable energy sources, in form of both hydropower and geothermal plants. Furthermore, the vision and energy policy of the government of Iceland, has had focus on having the country fully energy-independent by 2050, having both vehicles and fishing fleet using energy from renewable sources.

IX. Biographies

Unnur Stella Guðmundsdottir was born in Hafnarfjörður, Iceland in 1980. She received her B.Sc. degree in 2003 from The University of Iceland, and her M.Sc. degree in 2007 from Aalborg University in Denmark. She received an honours prise from the Danish Electrical Engineering society for her M.Sc. final thesis. Unnur Stella obtained her PhD degree from the Institute of Energy Technology, Aalborg University, in June 2010 where she also supervised students pursuing their M.Sc. degree in energy technology. Her PhD studies focused on modelling of underground cable system at the transmission level and were carried out for the Danish TSO (Energinet.dk). She was a guest researcher at SINTEF in Norway in November 2008 and at Manitoba HVDC Research Centre in Canada during June-October 2009. Currently she holds a position as a senior cable specialist and a Group Leader in Power Transmission at Energinet.dk, where she also is a deputy manager for DANPAC, a research project focusing on undergrounding of almost the entire Danish transmission system. Unnur Stella is also the owner of the company Maris StarCab Consultancy, which is active in Educational consultancy, giving lectures and power engineering courses throughout the world.

A Study of Measures to Satisfy the Growing Demand for Electricity in Zambia

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Abstract

It is well known that the use of renewable energy is an effective measure to reduce the emission of greenhouse gases such as CO_2. This is one of the dominant reasons why renewable energy has become very attractive, especially in advanced countries where large amounts of oil and coal are consumed in electricity-generation plants. Renewable energy is also valuable in underdeveloped and energy-poor countries, such as the African country of Zambia, because it is rather easy to put into place and it is less expensive than constructing a large thermal or hydraulic power plant. In this paper, we describe the current electricity situation in Zambia, and we investigate three measures that can be taken to satisfy the growing demand for electricity in that country. Zambia is located 1,000–1,300 m above sea level. The average precipitation per year is 500–1,500 mm, and the southern part of Zambia receives more rainfall than the northern part. The dry season is from May to September; the rainy season is from October to April. In 2008, the electricity generation capacity in Zambia was 1,860 MW. About 98% of that was covered by hydroelectric power plants. Industry is the main consumer of electricity, especially the mining industry, and its percentage is higher than 60%. The rate of electricity use has been increasing annually due to population growth, economic growth, etc. It is estimated that the population will increase 2.3% per year and the percentage of electrification will increase about 3.5%–6% per year. In addition, power generation always decreases during the dry season. Therefore, a higher generation capacity is required in order to satisfy future electricity demand in Zambia. Based on the investigation detailed in this paper, the following measures should be taken: (i) Incandescent lamps, monitors, and other household appliances such as TVs and PCs should be changed to light-emitting diode (LED) lights and products that use LEDs. This will reduces electricity use by about 80%. (ii) Photovoltaic generation should be introduced. (iii) Existing hydropower plants should be replaced by pumped-storage hydropower generators. This will enable energy storage during a light load and power generation during peak load.

1. Introduction

Electricity demand in developing and emerging countries has been increasing by the year due to rapid economic growth. How do such countries manage the supply and demand for this power? Many countries rely on thermal power, nuclear power, or both. However, issues regarding CO_2 emission and the risks of nuclear power are negatively impacting the people in these countries, as well as the world at large.

Some countries produce electricity using renewable energy almost exclusively, e.g., hydraulic power. In this paper, we will examine the case of the Republic of Zambia (Zambia). Economic development in Zambia is rooted in natural resources, such as copper, and the nation's economic structure is similar to that of other developing countries with dramatically growing economies. The demand for electricity in Zambia has been increasing dramatically each year. However, the government's policy does not include any plans to construct nuclear power stations or to increase the generation of thermal power. Zambia already utilizes renewable energy (hydraulic power), and the power generated in this way accounts for 98% [1] of the nation's supply of electricity. In addition, there are plans to introduce other forms of renewable energy in Zambia, especially solar power and wind power. Thus when Zambia satisfies all of the supply and demand for electricity using renewable energy, it will become a leading example in the movement to establish environmentally friendly energy sources.

In this paper, we investigate three measures to satisfy the increasing demand for electricity in Zambia. The first measure involves reducing electricity consumption, the second is photovoltaic (PV) power generation, and the third is a more efficient usage of hydropower generation, i.e., pumped-storage hydropower generation.

2. Current Electricity Situation in Zambia

Zambia is a lower-middle-income country. In 2012, its GNI per capita (Atlas Method) was 1,350 USD and the GDP was 20.68 billion USD. In 2010, the poverty head count rate at 1.25 USD (PPP) was 74.5% and its 2 USD (PPP) rate was 86.6%. It is apparent that there are many people who live at 2 USD (PPP) in Zambia. On the other hand, electricity consumption per capita in 2010 was 609.4 kWh [2].

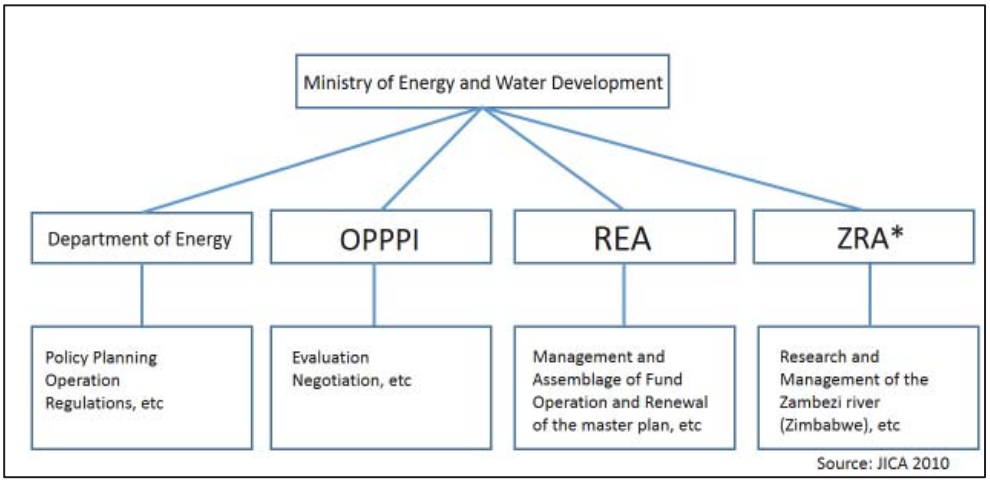

Figure 1. Structure of the electric sector in Zambia.
(This figure is based on the source from JICA 2010 [3].)

Figure 1 illustrates the structure of the electric sector in Zambia. The top of the sector is the Ministry of Energy and Water Development. There are four administration organizations: the Department of Energy, the Office for Promoting Private Power Investments (OPPPI), the Rural Electrification Agency (REA), and the Zambezi River Authority (ZRA). The Department of Energy focuses on policy planning and its operation, making laws to regulate the energy sector. The energy sector includes electricity, oil, coal, charcoal, and renewable energy. The OPPPI conducts the national energy policy, which includes making the electric services more efficient and introducing private capital into the development of hydraulic power plants. Thus the OPPPI mainly conducts evaluations and negotiations for policy administration. The REA was established by the Rural Electric Act. Thus it focuses on the management and assemblage of the rural electrification fund, the operation and renewal of the rural electrification master plan, etc. The ZRA researches and manages the Zambezi River, which is one of the trans-boundary rivers between Zambia and Zimbabwe [4].

There are three electric services companies: ZESCO, CEC, and LHPC. ZESCO stands for the Zambia Electric Supply Corporation, and it is a public company. CEC is the Copperbelt Energy Corporation, and it can be regarded as a private transmission company for the Copperbelt area. It deals exclusively with copper mining companies, but it has power stations operated by gas turbines with a total capacity of 80 MW. LHPC, which stands for the Lunsenfwa Hydropower Company, is also a private company. It is an independent power producer, and it sells electricity to ZESCO. Figure 2 illustrates the installed and available capacity of the power stations of each electric services

company [5].

Stations		Installed Capacity (kW)	Available capacity (kW)
ZESCO	Main Hydro	1,713,000	1,233,000
	Mini Hydro	23,750	12,750
	Diesel	7,285	6,545
CEC	Gas	80,000	80,000
LHPC	Hydro	38,000	38,000

Source: JICA 2010

Figure 2. Total installed and available capacity of power stations for electric service companies (JICA 2010 [6]).

Figure 3 illustrates the trend in the electricity supply and demand in Zambia. Export has been decreasing, and import began in 2002 as a result of drought and power stations maintenance issues. Meanwhile, electricity consumption has been increased remarkably since 2000. Most of the electricity is consumed by the mining sector (Figure 4), making it the key factor in the supply and demand for electricity. Figure 5 shows the trend in the consumption of electricity in Zambia. Apparently there is not a large difference between the dry and rainy seasons. Thus there is a need for a stable supply of electricity in Zambia.

From the above figures, it can be seen that Zambia relies mainly on hydraulic power stations, and growth in the demand for electricity will depend on the mining sectors. This demand will increase with economic development and a growing middle class.

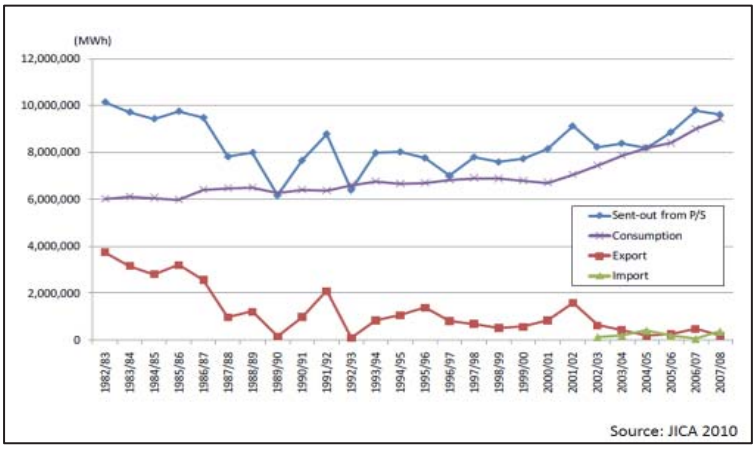

Figure 3. Demand and supply of electricity [7].

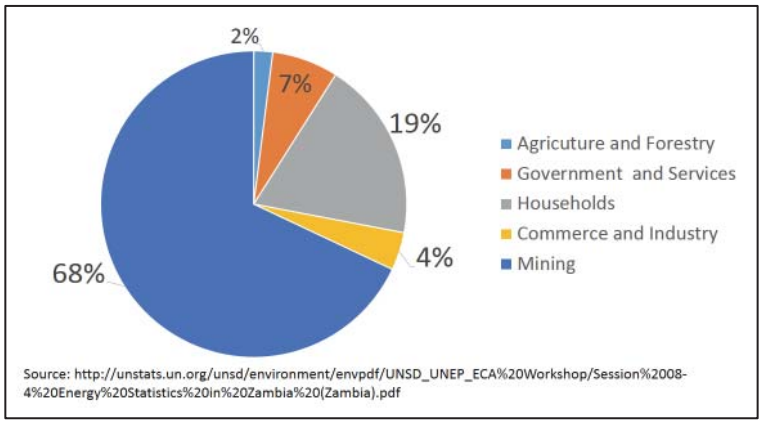

Figure 4. Consumption of electricity in each sector [8].

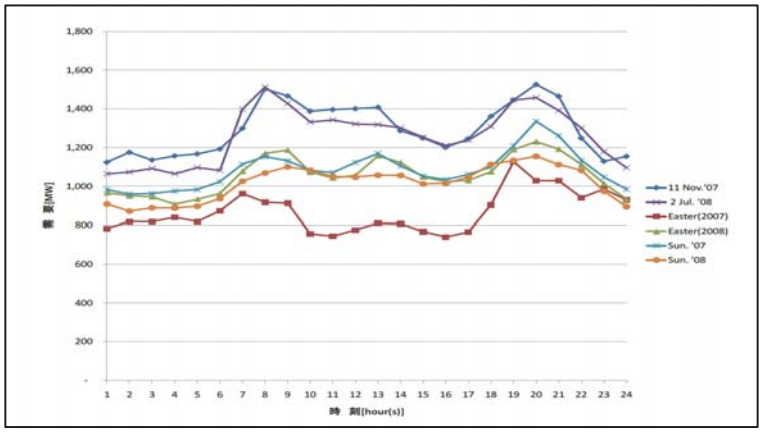

Figure 5. Trend in the consumption of electricity [9].

3. Prediction of the Demand for Electricity in Zambia

According to a study conducted by the Chubu Electric Power Co., Inc. (Chuden) thorough JICA, there are three prospects for the demand for electricity in Zambia: a base case, a low case, and a high case. These cases were calculated based on economic growth (GDP), population growth, and electrification. Figure 6 shows the elements of the prospects in each scenario, and Figure 7 shows the expected amount of electricity consumption in 2020 and 2030. The average power generation between 1977 and 2007 was about 8,400 GWh [10]. Thus the demand for electricity in Zambia will be at least twice the average in 2020 if it grows in accordance with the base case.

Scenario	Growth: GDP	Growth: Population	Electrification
Base Case	6%	2.3%	4%
Low Case	5%	2.3%	3.5%
High Case	7%	2.3%	6%

Source: JICA 2010

Fugure 6. Elements of the prospects in each scenario.

(The author excerpted and made the figure based on the source from JICA 2010 [11].)

Scenario	2020	2030
Base Case	16.6TWh	21.6TWh
Low Case	15.9TWh	19.4TWh
High Case	19.9TWh	28.5TWh

Source: JICA 2010

Figure 7. Prospects of the amount of the electricity in 2020 and 2030.

(The author made the figure based on the source from JICA 2010 [12].)

In 2010, the consumption of electricity in Zambia was 7.96 billion kWh [13]. Also, the percentage of the annual GDP growth in that year was 7.6%, and it has been increasing gradually since 2009 [14]. In addition, the average population growth between 2008 and 2010 was about 2.5% [15]. This average is 0.2% higher than Chuden's prediction. The expected consumption of electricity in 2010 was higher than the actual consumption, which was almost the same as in 2007. However, electricity consumption may surpass or be the same as the high case if the economy grows rapidly. In that case, the power generation capacity of about 1,000 MW will begin to run short after 2030 [16].

In the case of hydraulic power stations, the amount of power generation depends on the natural environment. Over the past 30 years, the total power generation decreased by 16% due to a shortage of water [17]. Thus, it is necessary to have power generation systems using renewable energies as well as thermal power stations to compensate for draught conditions. Also, attempts should be made to conserve electricity, because the supply and demand might not be balanced in the future.

In the next section, we will discuss three measures that should be taken to satisfy the demand for electricity in Zambia: conserving electricity, the application of photovoltaics (PVs), and pumped-storage hydropower generation.

4. Measures to Satisfy Electricity Demand

In this section, we investigate three possible measures to satisfy the increasing

demand for electricity in Zambia. There are two fundamental goals: (i) to reduce electricity consumption and (ii) to increase electricity generation.

4.1 Reducing electricity consumption

It is believed that one way to reduce electricity consumption is by replacing incandescent lamps and fluorescent lamps with LED lamps, which use less electricity. However, LED lamps are usually about ten times more costly than incandescent lamps. Thus, it would be difficult for people in developing countries to buy such expensive items. However, it is important to consider the change from incandescent lamps to LEDs in the case of Zambia.

The diplomatic conference for the Minamata convention on mercury was held on October 9–11, 2013, in Kumamoto, Japan. Ninety-two states have already signed the convention, and it will be executed after 90 days by the ratification of 50 states. The projected year of execution is 2016. The Minamata convention bans the production, import, and export of products that contain mercury after 2020. Zambia has already signed the convention, thus products that contain mercury will not be permitted in Zambia after 2020. Fluorescent lamps contain mercury, so it will be difficult to use them in Zambia after 2020. Therefore, making the change from incandescent lamps to LEDs will be a difficult but necessary challenge in Zambia.

How much electricity can be saved using LEDs? According to SHARP, which is a Japanese electric manufacturing company, the electric charge needed to power LEDs is one-fourth of the charge needed for incandescent lamps. A 40 W incandescent lamp will cost about 2,890 yen per year. In contrast, a 7.5 W LED will cost about 603 yen per year. Moreover, LEDs can operate for about 40,000 h, while incandescent lamps can only operate for 1,000 h [18]. According to Panasonic, which is another Japanese electric manufacturing company, the electric charge needed to power LEDs will be about one-fifth of that needed for incandescent lamps. A 60 W incandescent lamp will cost about 2,376 yen per year when used 5.5 h in a day, while a 9.2 LED will cost about 406 yen per year under the same conditions [19]. These two companies do not mention the cost of the LEDs, but it is clear that LEDs can operate longer than incandescent lamps, thus electricity will be conserved. In addition, LEDs do not contain mercury, so they can be used after 2020 even if the government of Zambia ratifies the Minamata convention on mercury.

Although LEDs have many advantages from the perspective of conserving electricity, it would be difficult for people in developing countries to buy them due to their high cost. Thus, it is important to create a kind of cooperative or system that

enables people to obtain LEDs. In Zambia, it might be a good idea to form a cooperative that combines multiple electric power distribution companies. Because the general population may find it difficult to pay the entire cost of an LED at one time, the cooperative could establish a payment system based on an installment plan. Then the cooperative could supply the LED lamps and collect the electricity charge by incorporating some of the cost of the LED to the total fee.

If the Minamata convention on mercury is ratified in Zambia, residents will be prohibited from using fluorescent lamps after 2020. Therefore, it will be necessary to replace incandescent lamps with LEDs from the perspective of the convention, and also to conserve electricity in Zambia.

4.2 Photovoltaic generation

Photovoltaic (PV) systems are another possible solution for the supply of electricity in rural areas that are isolated or not electrified. According to the JICA, the targeted electrification rate for rural areas in Zambia is 50.6% by the year 2030 [20]. However, even if that goal is met, about 50% of the people living in those rural areas will still not be supplied with electricity. The introduction of a PV system in rural areas may be a way to supply electricity to that portion of the population. In addition, the PV system could serve as a base of the pyramid (BOP) business. In this section, we will examine the possibility of introducing a PV system in a rural area from the perspective of contributing electrification in a business context.

The total amount of sunlight in Zambia over the course of one year is believed to be between about 2,600 and 3,000 h [21]. However, the government of Zambia has not conducted precise research, so it is difficult to identify specific places or target areas for the application of a PV system. Therefore, we will consider the application of PVs from the standpoint of electrification by a local company, and also as a way to facilitate businesses.

In many villages in the Philippines, there are solar battery-charging stations where people can charge their batteries and bring them back to their homes. It is likely that there are not many electrical appliances in these rural dwellings. Thus, the consumption of electricity might be lower than it is in urban areas, such as the city of Lusaka. People may use electricity for lights and to charge cellphone batteries, but there are very few TVs. Therefore, demand for electricity in rural areas will be low. It would seem that a small number of PVs could meet the demand for electricity in these locations.

As one of the activities performed by the Company for Social Responsibility (CSR), Panasonic provides a PV system to a village in Tanzania that does not have

electricity [22]. In addition, they also provide solar lantanas for Africa and Asia. The PV system is called a “life innovation container,” in that it is a container that has a PV on it. It is used to power TVs, refrigerators, and batteries for lights during the nighttime. Panasonic provides the container free of charge, and they perform occasional maintenance. This activity has a big impact on the residents of the village, because they can obtain electricity for free. However, is this situation beneficial over the long term? Maintenance is conducted by employees of Panasonic, so local residents will not know how to repair the container if a problem arises. It is necessary, therefore, to educate and train the local people how to maintain and repair the container. If people can obtain such knowledge, it will help them to get a job related to electrical engineering. There is every indication that PV systems will be popular in the future, so it would be advantageous to have such knowledge. Also, it would help the local people to establish a cooperative for the operation of the container. This cooperative will facilitate economic growth. Therefore, the village will benefit not just from the donation of the container, but also because it will be a trigger for business opportunities, which could have a dramatic impact on the lives of the residents. For example, Panasonic could rent a container at a very low price, and the local people could start a business using that container and share in the rental fee. At the same time, as part of the CSR, Panasonic would teach the people how to maintain the container. This process will take a long time, but the most important thing is that the container will be maintained and managed by the local people themselves. Therefore, a PV system can serve not only to supply electricity, but also to facilitate the economic development of a village from the perspective of Panasonic’s CSR.

In 2010, the mobile cellular subscription rate per 100 people in Zambia was 75.8% [23]. This rate is quite large, and it means that most of the people in Zambia possess a cellphone. However, many of these people do not have access to electricity in their homes, especially in rural areas. How do these people manage their cellphones by themselves? There are a number of small shops available for battery charging, and they operate during daytime hours. If a shop utilized electricity produced by a PV, it could turn into a lucrative business. It may be possible to combine these shops with the life innovation container.

The application of PVs on an individual level, especially in rural area, is difficult because of the high cost. Thus it is important to introduce PV systems in rural areas that incorporate a combination of companies, such as the CSR. As a result of this combination, the percentage of electrification in rural areas in Zambia may increase.

4.3 Pumped-storage Hydropower generation

There is an ample water supply in Zambia, and almost all of the country's electricity is generated by hydraulic power stations. However, the dams are not a pumped-storage system. Pumped-storage hydropower generators can be used to generate power during peak demand times. Thus, they could serve as a key power generation system in Zambia.

What is pumped-storage hydropower generation? It is a hydraulic power generation system that is usually used during electricity shortages. It pumps up water from a reservoir, such as a river, pond, or dam, by using surplus electricity that is generated during the night. Thus, pumped-storage hydropower generates electricity during the daytime, especially during peak time, and it pumps up water during the night [24].

What are the merits and demerits of pumped-storage hydropower generation? There are two main advantages: (i) It can be used to generate power during peak time. As was mentioned above, pumped-storage hydropower generation pumps up water during the night, so it is possible to supply electricity during peak time. (ii) It can serve as an emergency power supply when other power stations encounter problems due to accidents, natural disasters, etc. This type of power generation will become crucial when disasters or accidents occur and other power stations stop operating. However, pumped-storage generation can only operate for a few hours because it is designed for temporary power generation [25].

On the other hand, there are two primary disadvantages. (i) There is an environmental impact from this type of power generation, not only from a natural perspective but also from a social standpoint. When a pumped-storage hydropower generator is constructed, it usually requires the creation of an artificial reservoir. This can sometimes be detrimental to the natural environment. For instance, it may result in a decrease in area for wild animals and vegetation. It will also affect the residential area of the citizens who live on the building site of the reservoir. Some villages are covered over by the reservoir, forcing the citizens to relocate. This may have lingering psychological effects, as many people will have to leave the village where they have lived for a long time and move to a place that is unfamiliar to them. (ii) There is a risk of a dam burst. This may seem unlikely to many people, but it is an issue that will need to be addressed in the future. Of course, the possibility of a dam burst would depend on the strength of the materials used to construct the dam, or on the magnitude of an earthquake or a natural disaster such as heavy rain. Recently, there have been a number of extraordinary weather events around the world. One of the reasons for this may be

global warming. Thus, it will be necessary to consider the possibility of a burst dam and the ensuing damage.

Chuden formulated two plans for the development of power stations. The biggest difference between these two plans is the number of applications of thermal power stations using coal. In plan 1, only one thermal power station will be introduced; in plan 2, four thermal power stations will be introduced. As of 2016 or 2017, electricity demand during peak time will be greater than the supply if the demand grows according to the high-case scenario in plans 1 and 2.The deficit would be about 100–200 MW. However, there would not be a large gap between demand and supply, although there would occasionally be blackouts. Thus, it would be prudent to introduce pumped-storage power generation in Zambia for peak time and to satisfy the future demand for electricity. Chuden's plans for Zambia would be suitable to manage the demand and supply of electricity. However, in addition to these plans, it might be possible to supply electricity via pumped-storage power generation for peak time. The surplus electricity could then be sold to neighboring countries.

5. Conclusion

In this paper, we examined the current electricity situation in Zambia, and we presented examples of different ways to conserve electricity. The demand for electricity in Zambia will increase. The current demand fluctuates between the base case and the high case, which was predicted by Chuden. If demand exceeds the high case, there will be many blackouts. Thus, it is urgent that residents of Zambia find ways to conserve electricity.

This article details three ways to respond to the increasing demand for electricity in Zambia. (i) Change from incandescent lamps to LEDs, (ii) establish PVs in rural areas, and (iii) construct pumped-storage power generations. The first measure, i.e., use of LEDs, represents a big challenge for Zambia. However, use of products that contain mercury will be banned after 2020, when the government of Zambia ratifies the Minamata convention on mercury. Therefore, the second measure, i.e., the application of a PV system in rural areas to increase electrification, is an attractive alternative. It is difficult to distribute electricity immediately to areas that are not electrified. However, renewable energy, especially PV systems, will enable that immediate distribution of electricity, although the cost may be high. Therefore, it is important to introduce PV systems in rural areas that can be used by businesses. The areas that are not electrified will be targeted by a company that will try to start a BOP business using the PV system. If a number of companies succeed in establishing BOP businesses, as was mentioned in

section 4-2, this will contribute to electrification as well as development in the rural areas. Finally, the third point, i.e., introducing pumped-storage hydropower generation for use at peak times, also has merit. This type of power station has some disadvantages, but it would serve as an emergency power supply in the event of a disaster. Thus, it would be beneficial to have such power stations in addition to Chuden's development plan.

Based on the investigation detailed in this paper, the following measures should be taken: (i) Incandescent lamps, monitors, and other household appliances such as TVs and PCs should be replaced by light-emitting-diode (LED) lights and products that use LEDs. This will reduce the use of electricity by about 80%. (ii) Photovoltaic generation should be introduced. (iii) Existing hydropower plants should be replaced with pumped-storage hydropower generators. This will enable energy to be stored during periods of light load, and power to be generated during peak load.

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Reconstruction of Syria's Electric Power Infrastructure using Renewable Energies

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Abstract- In this paper, we discuss the possible installation of photovoltaic power generation systems in southeast Syria, which is an area with no transmission network. We also examine other forms of renewable energy, including solar heating of water, wind farms, and small hydroelectric generators. Compared with other methods, a hydroelectric generator has a comparatively high capacity, lower cost, and very high efficiency. Therefore, it should be the first choice if there is an available water flow. A wind turbine generator should be the second choice because it can operate continuously in favorable weather conditions, and it is easier to maintain than a photovoltaic generation system. A photovoltaic generation system requires storage and a power conditioner, both of which are rather expensive. It also has a shorter lifetime, and there are certain disadvantages with regard to temperature. In Syria, the daily temperature can fluctuate by as much as 20 °C, which can lead to significant thermal fatigue. To reduce aging due to temperature fluctuations, it is possible to implement a combined photovoltaic and solar heating system in which water can be heated during the day, stored in an insulated container, and used at night to maintain the photovoltaic panels at a constant temperature. The heated water can also be used in people's homes for air conditioning and personal hygiene.

1. Introduction

The ongoing civil war in Syria has resulted in a damaged energy infrastructure, and many regions remain isolated from the power network [1, 2]. Since a reliable energy infrastructure is indispensable for social development, we must quickly repair the damage and utilize the available resources in Syria to fulfill their energy needs. However, it may be a long time before the current energy infrastructure can be reconstructed to the point that it is able to provide electricity for these isolated regions. Therefore, alternative systems should be proposed. Fortunately, Syria is in a favorable geographic location with available water, wind, and solar energy resources [3] from which electricity can be obtained using micro-scale power generation systems [4]. Electricity from such systems can be distributed directly without the need for transmission lines, and can be easily deployed and operated without consuming additional fuel.

An estimated 17% of the Euphrates River passes through Syria, and there is an average annual flow of 36 cubic kilometers [5] from which hydroelectric power can be harvested. Solar energy is widely available in the desert in Syria, with an average annual solar irradiance of 1900 kWh/m^2 [6], and the northeast region is suitable for wind power generation, with wind speeds reaching over 7 m/s [7]. These energy resources can be used to satisfy part or all of the electricity demand in Syria`s isolated regions. However, any power generation system selected should also be scalable in power generation capacity, and it should be able to be integrated into the existing infrastructure over the long term.

In this article, a roadmap for the restoration of Syria`s energy infrastructure is proposed, with a focus on providing electricity to the isolated regions and implementing renewable energy power systems with scalability that may later be incorporated into the current power network.

2. About Syria

In 2009, gross power generation in Syria reached 43,309 GWh, a 5.6% increase over the previous year. Electricity consumption per capita grew 7.4% from 2000 to 2010, to an estimated 1,905 kWh per capita [7-9]. Divided into sectors, residential electricity consumption in 2010 was the highest, with 15,830 GWh, followed by 8,445 GWh from the industrial sector [7]. However, electricity distribution was unbalanced between different regions in Syria. Only the north and center regions received enough power to satisfy the demand, while the south, west, and northeast regions faced power shortages [7]. Furthermore, Syria has been importing electricity since 2006, reaching a total estimate in 2010 of 13.6 GWh from Jordan, 139 GWh from Egypt, and 330 GWh from Turkey [7]. As a result of the current civil war, the transmission lines supplying electricity to the northeast region were also damaged, and this region is now receiving only one hour of electricity per day [1]. Furthermore, gross power generation drastically decreased to 21,655 GWh in 2013, although it is expected to start recovering by 2015 (as shown in Figure 1) [10].

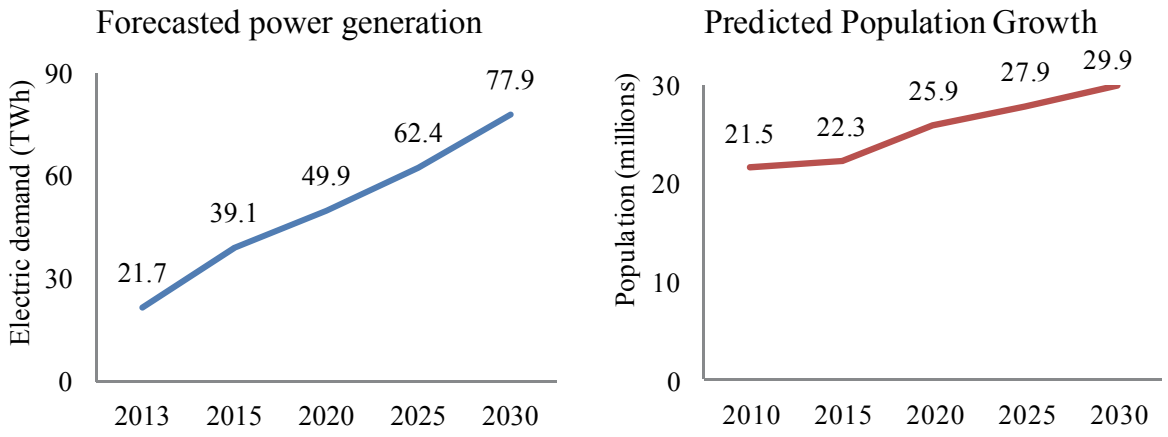


Figure 1. Forecasts for power generation and population growth in Syria [7, 10].

This article is based on data and forecasts from the current situation in Syria. The reconstruction roadmap is considered starting from the ceasefire in 2013. The electric power infrastructure has been damaged due to the conflict, resulting in a decrease of 50% of the available power plants, transmission lines, and distribution lines compared with 2009. Thus, gross power generation in 2013 considered in this study is 21,655 GWh, as illustrated in Figure 1.

3. Planning

The first part of the reconstruction roadmap for Syria involves providing electricity to the settlements that lack access to the national power grid. Micro-scale power generation systems are effective methods for supplying electricity in isolated regions, as no power transmission lines are required and the reduced size of the system allows for rapid installation. Although diesel-fueled electric generators are the most commonly used systems for this purpose, they require a constant supply of diesel fuel, which is difficult to obtain in isolated regions. In contrast, solar and wind energy systems can provide electricity in any region as long as the weather conditions are favorable, and

hydroelectric power can be utilized wherever there is an available source of running water. Although these systems may not provide a completely reliable source of electricity over the course of a year, they will greatly benefit those in need until the electric network can be fully restored. The viability and implementation strategies of these systems are explained in the following sections.

Once the isolated regions have obtained access to electricity, and after a transition government is established in Syria, the damaged power transmission and distribution lines will have to be rebuilt. After that, the regions where micro-scale power generation systems were installed should also be integrated into the electric network to provide them again with a stable and reliable power output. Subsequently, expansion of the power generation capacity will be sought using renewable resources. Toward that end, it is important to choose a suitable region. Both wind and solar power systems require a large, relatively flat land area with abundant wind and sunshine, while hydroelectric power requires a constant source of running water, which is scarce in the Syrian Desert.

3.1. Possible generation system

3.1.1. Hydroelectric power

Micro-scale hydroelectric power generation systems can be implemented as an inexpensive method for power generation with a constant output [11]. The limitation of these systems is that they must be located next to a source of running water. The regions in Syria that are isolated from electricity are mostly located in the north and east [12], where the banks of the Euphrates and the Khabur are located. The flow of the Euphrates River is controlled by the Tabqa Dam in Assad Lake, and the discharges from this dam are further stabilized by the smaller Baath Dam, which is located 18 km downstream [13]. The Euphrates flows into Iraq with an annual mean discharge rate of 734 m^3/s. The Khabur River merges with the Euphrates near the town of Busayrah, and it has an average discharge rate of 45 m^3/s [14].

The power output and installation costs depend heavily on the terrain and the head (i.e., the height difference from the water inlet and the water turbine), but a 100-kWh system may be obtained with a flow of one cubic meter per second and a head of 17 m. Variation of the head and the number of turbines is needed to design the system in a specific region. For this type of technology, electricity cost is estimated at 13 JPY/kWh, with an installation cost of approximately 900,000 JPY/kW [11].

3.1.2. Photovoltaic power

Due to the modularity and easy installation of photovoltaic power systems, they can be ideal for power generation in isolated regions. They can be installed as standalone power systems to supply electricity directly in each residence, without the need for interconnection. Such systems are independent from fuel and from the electric grid, and they can be installed anywhere with almost no terrain limitations. However, these systems are still dependent on weather and diurnal cycles, and power output may be available when it is not needed, resulting in large energy waste. In contrast, communal photovoltaic power stations can be utilized in a community as a center for recharging batteries. In that case, efficiency losses due to recharging, as well as the inconvenience of having to transport the battery to the recharging station, are tradeoffs for the ability to obtain electricity on demand

One of the disadvantages of a photovoltaic power system is that high temperatures and large temperature

gradients damage the panels and shorten their lifetime. The average daily solar irradiation in Syria is about 5 kWh/m^2. In the Syrian Desert, maximum temperatures often surpass 40 °C, and temperature gradients larger than 20 °C are frequent. To prevent overheating of the photovoltaic panels, a cooling system must also be implemented. Furthermore, if the heat removed from the photovoltaic panels during the day is stored in an insulated container, it can be used during the night to heat the panels, allowing them to cool gradually and avoid sudden changes in temperature. This process would mitigate thermal fatigue and extend the lifetime of the system.

The power output capacity in photovoltaic systems depends on the area covered by the panels having an approximate energy density of 170 W/m^2. These systems have an average lifetime of 20 years under normal conditions. The cost of electricity from this source is around 53 JPY/kWh, with an installation cost of 690,000 JPY/kW. For rechargeable batteries, lead-acid batteries are the least expensive type, and they are frequently used for stationary applications. They have a lifetime of 4,500 cycles, an energy density of 35 Wh/kg, and a cost of 150,000 JPY/kW [11].

3.1.3. Wind power

Wind power generation systems require wind speeds over 5 m/s at 10 m above ground level, and they should be installed in a relatively flat and open land, as mountains, forests, and other tall obstacles will decrease wind speed. For these systems, the power output is dependent on the swept area of the turbine. They also require an area of land of roughly 0.25 acres for each turbine to avoid turbulence generated by other turbines, although this land may still be used for other purposes, such as farming. Energy density for wind power is variable, depending on the wind speed. At higher altitudes, wind speed increases and a higher energy density is expected. The cost of electricity for offshore wind power is estimated at 5 JPY/kWh, with an installation cost of 300,000 JPY/kW [11].

The most harmful weather conditions for wind power systems in the desert are sandstorms, which may damage the surface of the blades and the internal components. The extreme temperatures in the desert also negatively affect wind turbines. The current technology has been improving in this area, and wind power farms that can withstand sandstorms and low temperatures have already been installed in Guangdong, China [15].

3.2. Location

The optimal location for future expansion of the electric network, using renewable energies, appears to be the region southwest of the city of Deir Ez Zor and southeast of the Jabal Bishri mountain range. This region is selected due to its advantageous weather and geographical conditions, and because it is close to one of the largest cities and power transmission stations in the region. Figure 2 displays the location of the selected region.

About 25 km south of Deir Ez Zor, there is an inhabited flat region covering an area of several square kilometers. Close to this area, 13.5 km southwest of Deir Ez Zor, there is the Al Tayem power plant, a 100 MW open cycle gas turbine power station [17], which closes the electric network loop between the northeast and south regions in Syria [7]. Furthermore, annual solar irradiance in this region is around 2,100 kWh/m^2, making it suitable for solar power generation (as shown in Figure 3). Additionally, the region also has a great deal of wind resources, which allow the use of wind power systems (as shown in Figure 4). This region is also close to the Euphrates River before it merges with the Khabur River, with an annual mean flow rate of 690 m^2/s [14]. The availability of water in this

region may be helpful for cooling solar power systems. In addition, energy storage systems based on water storage may also be possible using water from the Euphrates.

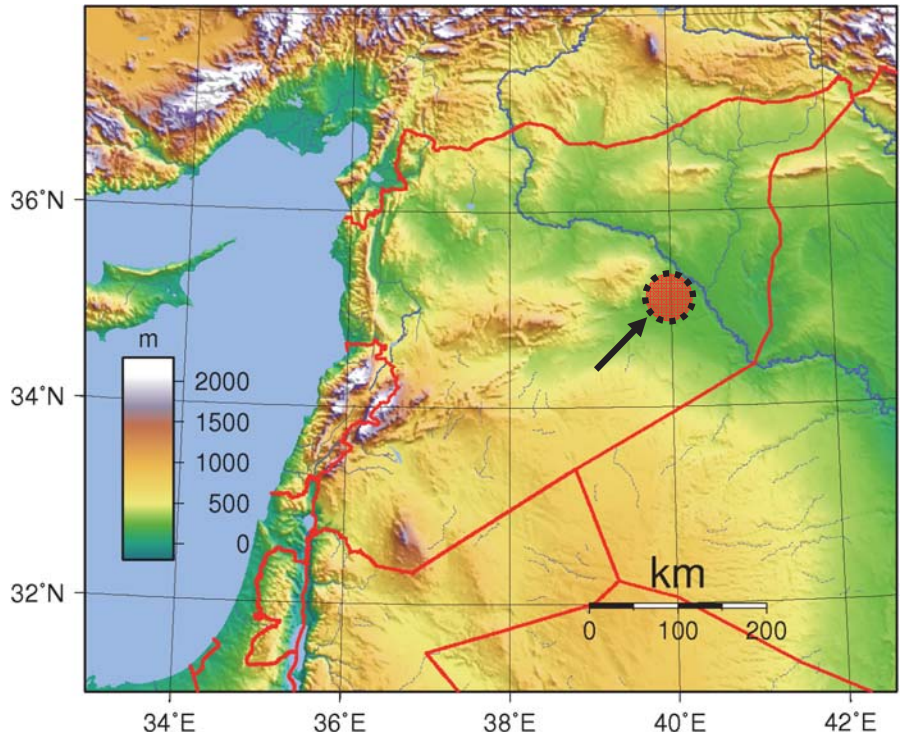


Figure 2. Relief map of Syria showing the region selected for future expansion of power generation [16].

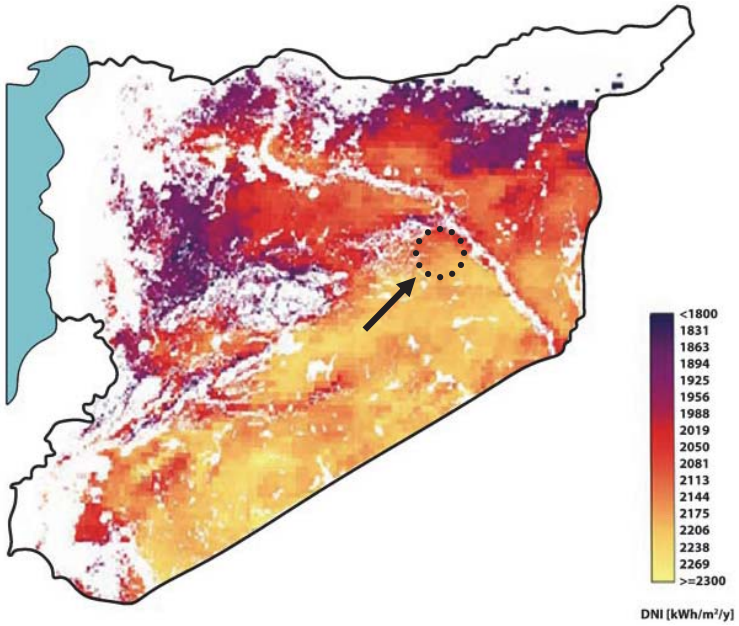
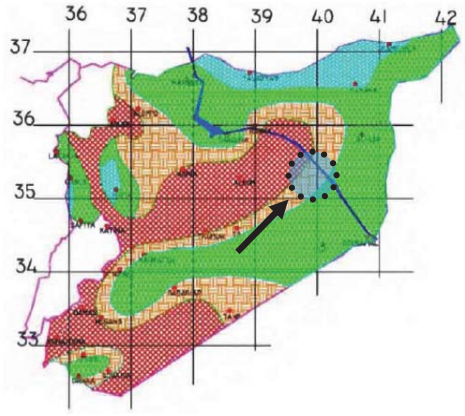


Figure 3. Annual mean solar irradiation in Syria, showing the region selected for future expansion [6].



	Unopened Area (City, Forest)	Open Area (Low Trees)	Sea Shore (Low Glass)	Sea Surface (10 km in the sea)	Hills	Area
	m/sec					m²
	5-6	6.5-7.5	7-8.5	8-9	10-11.5	54,000
	4.5-5	5.5-6.5	6-7	7-8	6.5-10	45,000
	3.5-4.5	4.5-5.5	5-6	5.5-7	7-8.5	75,000
	3.5<	4.5<	5<	5.5<	7<	13,000

Source: Syria's Master Plan for Renewable Energy

Figure 4. Wind speeds in Syria, showing the region selected for future expansion.

4. Water resource management

Power generation systems using solar and wind energy have a variable output that depends on the weather. In the case of Syria, the peak demand of electricity in summer happens at 23:00 hours [7], while power from solar energy is only available during the daytime. This causes a surplus in power generation that must be used in another way to avoid wasting the electricity. Underground dams may be an effective method for utilizing surplus electricity from wind and solar power systems, while also benefiting the farming industry. By diverting and storing water from the Euphrates into underground dams, we can later use surplus electricity during the daytime in the summer to pump the water back to the surface and use it for irrigation. An illustration of underground water storage systems is presented in Figure 5. Additionally, water reservoirs can also be dug on the surface; these reservoirs consume less energy in the pumping process because they are closer to the surface. Although they are less expensive and easier to construct than underground dams, surface reservoirs are subject to heavy evaporation, especially in the weather conditions of the region discussed in section 3.2. Economic insulators made from palm fibers are being tested in Saudi Arabia, and they appear to reduce evaporation significantly in surface water storage tanks.

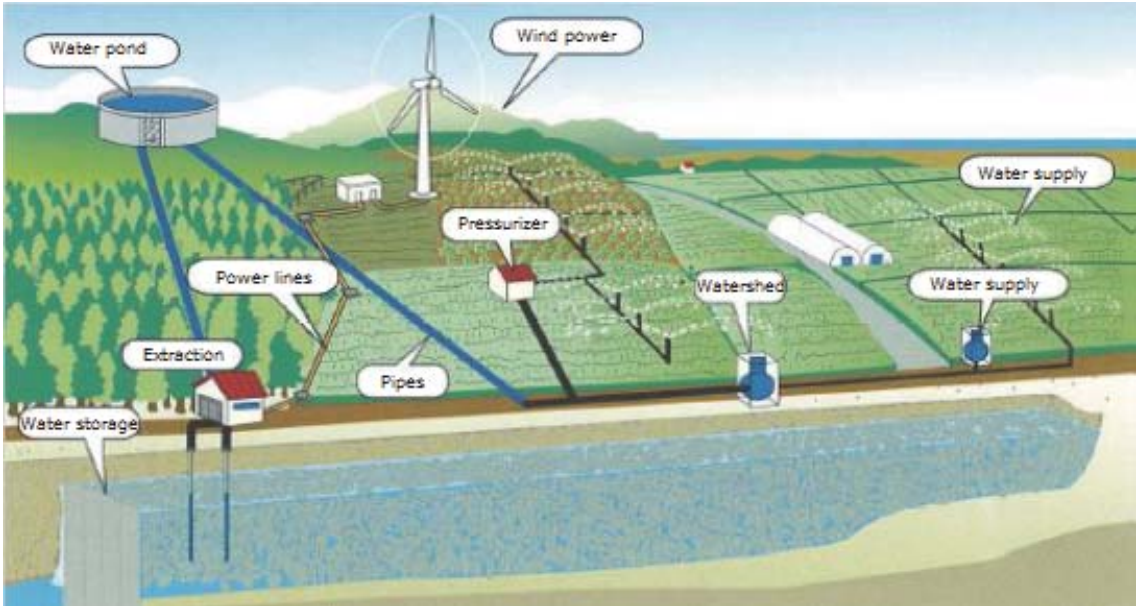


Figure 5. Underground water storage systems [18].

5. Roadmap

Considering the assumptions and strategies discussed in the previous sections, a roadmap for reconstructing the electric power infrastructure of Syria was developed. The roadmap is divided into ten major stages.

(1) Ceasefire

Reconstruction of the power infrastructure will begin after a ceasefire is declared in the current conflict in Syria. The damage to the electric infrastructure has decreased power generation to 21.7 TWh, and it has left the northeastern part of Syria isolated from the power network. After the ceasefire, currently occupied power stations and military active settlements will gradually come back into use.

(2) Photovoltaic and hydroelectric power systems distributed to isolated regions

Standalone photovoltaic power systems and rechargeable batteries will be distributed in regions without access to electricity. Batteries will be used to provide electricity to residences, and they will be recharged in a photovoltaic power recharging station. Hospitals and schools will receive independent systems to ensure a constant supply of electricity. Micro-scale hydroelectric power systems will be installed in the northeast region in the Khabur River to partially restore electric supply.

(3) Transition government

A transition government will be established that can manage planning and investments for reconstruction of the energy infrastructure. The government will need to analyze priorities with regard to the treatment of victims, reconstruction of damaged cities, restoration of jobs and the economy, and reintegration of the country.

(4) Repair transmission and distribution lines

Restoration of the damaged electric transmission and distribution lines will be required to connect the northeast regions back to the electric network. Supplying electricity back to this region is expected to lead to an economic boost. Expansion of the distribution lines to cover the isolated regions also needs to be considered, although priorities in the restoration of other sectors may delay this stage.

(5) Renewal of the hydroelectric power plants

The Tabqa Dam currently generates only 150 MW out of the 800 MW installed hydroelectric power plants due to a lack of maintenance and a lower water flow coming from Turkey [13]. Renovation of the facilities would increase the power output and greatly reduce the pressure on the amount of natural gas consumption for electricity generation. With the transmission and distribution lines restored, the increased power output from the Tabqa Dam would be able to satisfy the electricity demands of the south, west, and northeast regions, which currently face power shortages.

(6) Redistribution of the photovoltaic power systems

Once electric supply has been restored to currently isolated regions, the photovoltaic power systems that will be distributed in stage 2 of this roadmap should be collected and redistributed into other regions without access to electricity. As the electric supply starts to be restored in more regions and the photovoltaic panels are no longer needed, they should be recollected to form a large-scale power plant, located in the region discussed in section 3.2. By grouping the photovoltaic panels, better management in cooling and energy storage can be achieved, with the possibility of future expansion by interconnecting additional photovoltaic panels.

(7) Raising the fee for electricity among residents

The Assad regime sought to appeal to the Syrian people by providing easy access to electricity and maintaining a low price for residential use. With the current price of electricity, the annual electric fee for a six-person household comes to about 43 USD, which is equivalent to 0.2% of the total Gross National Income [7, 9]. To obtain funds to improve the energy infrastructure using renewable energies, it might be reasonable to increase the price of electricity and use the additional income to carry out the restoration plans. By raising the capacity of renewable energy systems, Syria would see a decrease in natural gas consumption, which can in turn be exported to further increase the income of the energy industry.

(8) Wind power and water storage systems in Deir Ez-Zor

The expansion of power generation using renewable energies should be continued in the region south of Deir Ez-Zor, which was discussed in section 3.2, with an installation of wind farms and water storage systems discussed in section 4. This power plant can be connected to the electric network through the Al Tayem power station. The storage of water should be carefully managed so as not to decrease significantly the flow of the Euphrates into Iraq and to maintain the flow rate into Iraq at 60% of the total flow, as established in the agreements for international water usage [19].

(9) Concentrated solar tower system in Deir Ez-Zor

Solar photovoltaic systems have decreased efficiency in high-temperature regions. Therefore, concentrated solar tower systems, which can benefit from the high solar irradiance in the region, should be considered instead. Energy storage in concentrated solar power systems is more cost-effective and can last from 1 h (using steam as an energy carrier) to up to 16 h (using molten salts as an energy carrier). Although the cost is higher and the construction time is longer for these kinds of systems, they exhibit more reliability and a longer lifetime than photovoltaic power systems.

If the concentrated solar tower technology is out of reach for Syria, photovoltaic power systems should be utilized instead, as long as they are properly cooled and maintained.

(10) Shift to an electricity-exporting country

Once the power infrastructure in Syria is reconstructed and there is promising growth, Syria should reduce or stop its electricity imports and become an electricity-exporting country. The natural resources available in Syria (natural gas, water, wind, and solar energy) appear to be enough for Syria to not only become energy-independent, but also to produce sufficient electricity for exporting.

6. Future plans

The potential growth that is expected for photovoltaic and wind power systems in Syria is shown in Figure 6. Figure 4 shows that there are many other regions with strong wind speeds where wind energy may be harvested, and a linear growth for installed capacity is expected in this area. As for photovoltaic systems, there is potential growth, but not as much as for wind power.

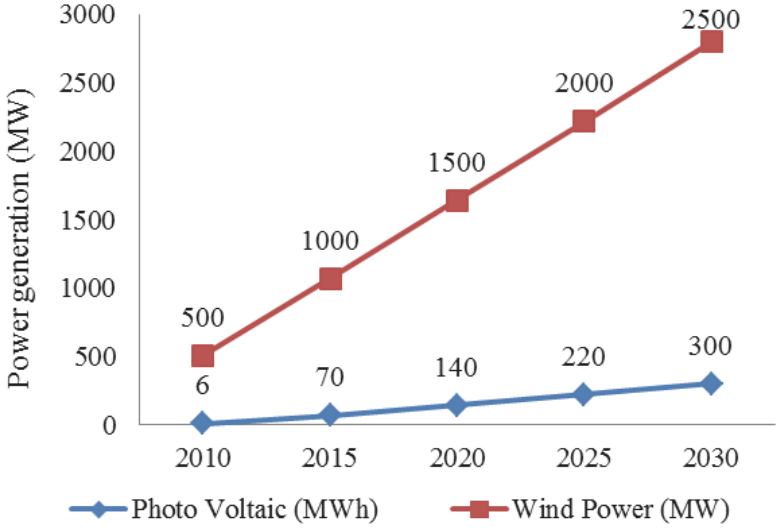


Figure 6. Future plans for wind and photovoltaic power generation [7].

7. Conclusion

In this article, we present a roadmap for the reconstruction of Syria's electric power infrastructure using renewable energies. The current conflict in Syria has resulted in severe damage to various components of the power infrastructure, and it has left some regions with little or no access to electricity. Several methods for electricity generation using renewable energies are discussed in this article, and a strategy for implementing them is discussed. To begin the restoration, a ceasefire is assumed under the current conditions in Syria. After this, micro-scale hydroelectric, standalone photovoltaic, and wind power systems will be distributed to provide electricity to the currently isolated regions. After a transitional government is established, the reconstruction and renewal of various facilities in the power network is expected, followed by the development of additional power plants using renewable energies. For this purpose, a region with suitable weather and geographical conditions is proposed and analyzed. In addition to the power plants, water storage systems are also proposed that can utilize surplus energy from the power systems to pump water into the irrigation systems of nearby farm lands. With the proposed strategy, an increase in

natural gas and electricity exports is expected for Syria, while maintaining an extensive and reliable power infrastructure.

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Electricity Supply to a Local/Isolated Area by Means of Renewable Energy

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1. Introduction

There are a number of areas in the world where electricity supply is always limited. Some typical examples include mountainous areas in Asia and the Far East, and a desert in Africa. Such areas do not have a well-established transmission/distribution system, and no fuel can be supplied. The most promising solution, therefore, is to establish locally dispersed electricity generation. In this paper, we discuss the possibility of generating electricity using renewable energy, including micro-hydraulic power, wind power, and photovoltaic solar power. For a small village with a population of 100 and the necessary generation capacity of about 10 kW, we attempt to determine the best choice for electricity generation by investigating the following methods: a small hydraulic turbine, a wind turbine, or photovoltaic solar generation. This choice is dependent on geological and climate conditions. Therefore, the investigation is carried out under various conditions, and the cost, maintenance, and lifetime of the methods are discussed.

2. Small Hydroelectric Generation

2.1 Water resources

Table 1 displays climatological information for Douala, Cameroon [1]. It is expected that there will be a sufficient water supply from March to November in this case. A similar situation also exists in the countries of southeast Asia. In such an area, hydroelectric power generation appears to be the most suitable method.

Table 1 Climatological information for Douala, Cameroon

Location of water station: 4.0 N, 9.7 E, altitude: 5m

	Data Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Maximum Temperature (deg. C)	1962-1990	31.7	32.3	32.1	31.9	31.2	29.4	27.6	27.3	28.6	29.6	30.6	31.3
Mean Temperature (deg. C)	1962-1990	27.5	28.1	27.8	27.6	27.2	26.2	25.1	24.9	25.6	26.1	26.9	27.2
Mean Minimum Temperature (deg. C)	1961-1990	23.3	23.9	23.5	23.4	23.2	22.9	22.6	22.8	22.7	22.6	23.2	23.2
Rainfall Amount (mm)	1961-1990	35.5	63.6	168	230	272	429	650	755	626	410	134	34.8
Days with Rain*	1961-1990	5	9	16	18	27	30	27	30	27	25	16	6
Mean Daily Sunshine Duration (hours)	1961-1990	6.2	6.4	5.5	5.9	5.7	4.1	2.3	1.7	3	4.2	5.4	5.9

*denotes number of days with at least 1.0 mm of rainfall

2.2 Scales of hydroelectric generation and generating capacity

Table 2 displays the scales of hydroelectric generation [2-4]. It is clear that micro hydroelectric generation is the best method for the assumed capacity of about 10 kW. Fig. 1 illustrates the principle behind hydroelectric power generation, and Eq. (1) shows the generating capacity of a hydraulic turbine generator.

Table 2 Scales of hydroelectric generation.

Type of hydroelectric	Scale (output capacity)	Cost ¥×10⁴[Yen/kW]
Large hydro power	100 MW ~	<50
Middle hydro power	10 ~ 100 MW	<50
Small hydro power	1 ~ 10 MW	<50
Mini hydro power	100 kW ~ 1 MW	50 ~ 75
Micro hydro power	~ 100 kW	75 ~ 150

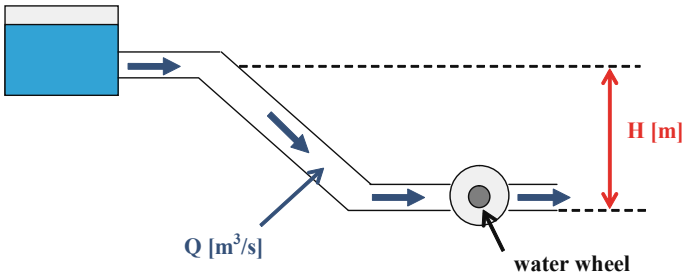


Fig.1 Principle of hydroelectric power generation.

$$P[\mathrm{kW}] = g[\mathrm{m/s^2}] \times H[\mathrm{m}] \times Q[\mathrm{m^3/s}] \times E_{ff}[\%] \quad (1)$$

where, P denotes the electric power generation capacity, g denotes gravitational acceleration (9.8 m/s^2), H denotes a drop of water, Q denotes the quantity of water, and E_{ff} represents the conversion efficiency (about 80%). Substituting g = 9.8 (m/s^2) and E_{ff} (efficiency) of about 0.75, the equation is simplified as

$$P \fallingdotseq 7.5HQ \quad (2)$$

2.3 Features of hydroelectric generation

Hydraulic turbine generators are advantageous because they are very reliable and efficient, they require less maintenance, they have a long lifetime, they are easy to plan with, and they are readily available.

2.3.1 Reliability

If there is no significant change in the water flow rate of a river during the day, electric energy is generated with "high quality and efficiency." Therefore, compared with other types of electricity generation, such as solar power and wind power, hydropower can supply about three to ten times more electric power per year than other methods. Also,

no battery is needed for hydropower, therefore it is can always be used.

2.3.2 Easy to plan

Power output and electricity quantity can be predicted accurately and easily if we can measure the quantity and height difference of the water.

2.3.3 Easily available

Solar and wind power require normalization of fluctuated outputs for the design. For hydropower, it is necessary to design the water flow in a pipe in order to function in the various environments of canals or rivers, and its design is dependent on each specific region.

2.4 Design and cost of 10kW generation

Assuming a generating capacity of P = 10 kW, the following water flow condition is required:

$$\mathrm{H}\cdot\mathrm{Q}=1.3 \quad [\mathrm{m}\cdot\mathrm{t/s}],\quad 1t=1\mathrm{m}^3 \text{ water} \tag{3}$$

The above condition can be satisfied by a small river. The design of the generator station is done as follows:

(1) Pre-feasibility study phase

Preliminary site studies for the potential power.

Obtain the necessary authorization.

(2) System design phase

Actual design of the system.

This is dependent on the size of the system and the complexity of the site characteristics.

(3) Installation phase

System components.

Equipment and necessary labor.

(Grid connection costs if necessary.)

(1) Operation phase

Monitor the installed system.

Necessary maintenance.

Based on data from Japan, the total cost appears to be about 10 million Japanese Yen [4].

3. Wind Power Generation

3.1 Wind energy in the world

Fig. 2 displays the world's mean wind speeds [5]. It can be seen that sufficient wind energy is present in coastal areas. Thus, wind power generation might be the best choice along sea coasts and on islands.

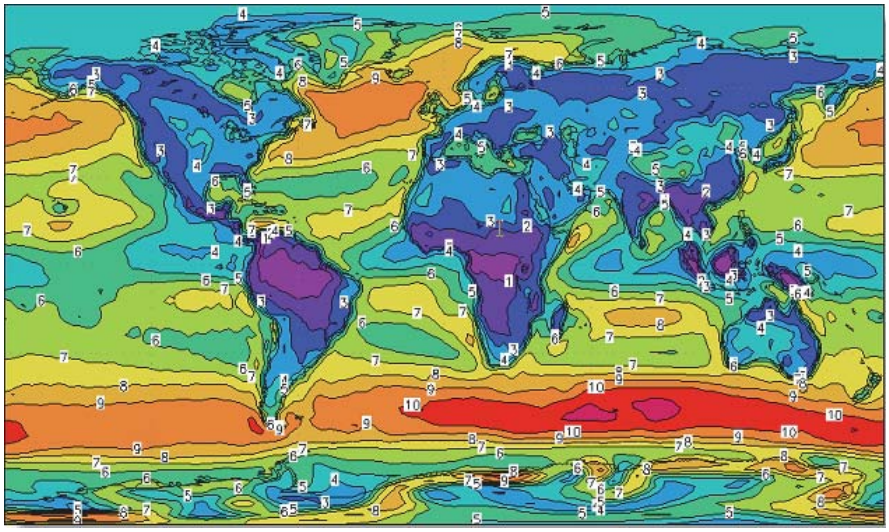


Fig. 2 The mean wind speed in ms^{-1} at 10 m above ground level for the period 1976–1995.

Reference: the NCEP/NCAR reanalysis data set

Fig. 3 illustrates a typical example of electricity consumption on an isolated island [6]. In this example, the highest load occurs after 6 p.m., thus photovoltaic power generation is not effective unless a storage and power conditioner system, which is rather expensive, is installed.

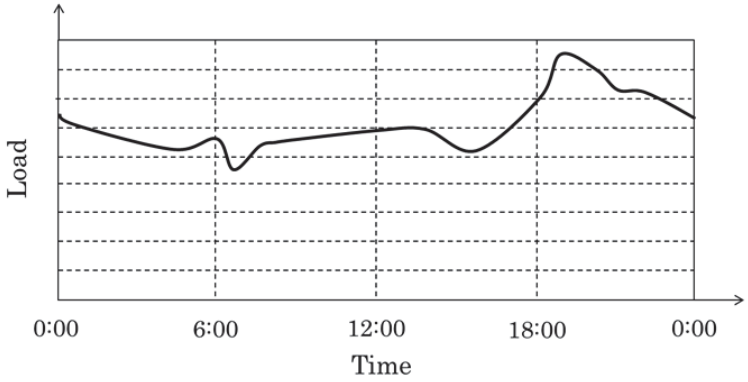


Fig.3 Typical electricity consumption on an the isolated island.

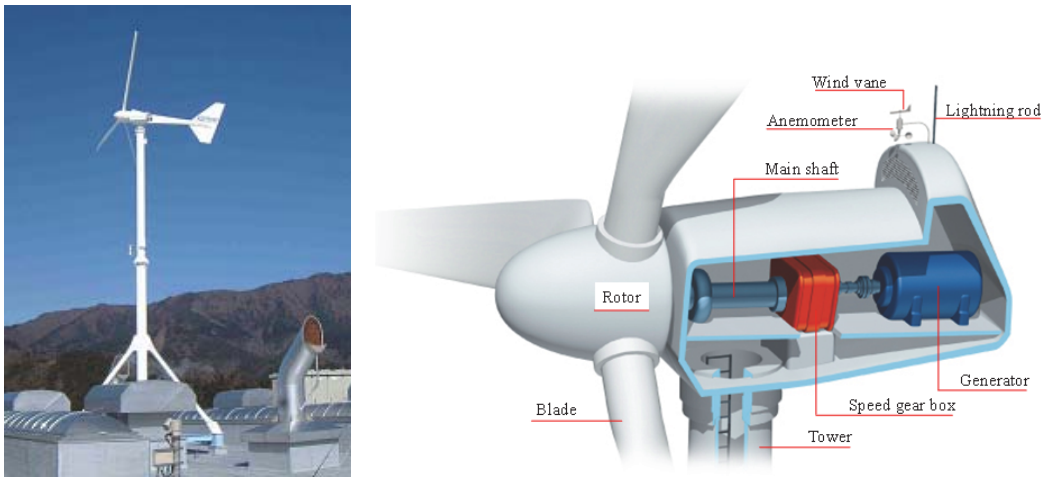
3.2 Principle of wind generation and generating capacity

Fig. 4 shows a photo depicting wind power generation [7]. Wind energy is energy from moving air caused by temperature differences in the atmosphere. Wind turbines capture the air flow by converting it into a rotational movement, which subsequently drives a conventional electricity generator. This principle corresponds to capturing water flow in a water power system. The theoretical power of the air movement is given by

$$P = \frac{1}{2} m v^2 \times \eta = \frac{1}{2} \rho A v^3 \times \eta \cong 0.18 A v^3 \left[\mathrm{kg \cdot m^2 / s^3}\right] = \left[\mathrm{W}\right] \tag{4}$$

where m denotes mass (kg), P denotes electric power generation (W), ρ denotes the density of air, which is around 1.22 kg/m³, A denotes the cross-section area in which the air flows (m^2), v denotes the velocity of the air (m/s), and η denotes the efficiency of the power generation (%), e.g., around 30% in case of the three-blade generator.

To generate $P = 10$ kW, $Av^3 = 56$ (kg m^2 / s^3) is required.



(a) Wind power generation (b) Nacelle cross section

Fig.4 An example of the wind power generation.

3.3 Design and costs

3.3.1 Wind power generation only

If we design for only wind power generation, a 20 kW capacity is required to supply 10 kW, considering a working ratio of about 50%. Table 3(a) indicates the estimated cost for only wind power generation [4].

Table 3 Estimated cost.

(a) Only wind power generation

Component	Cost ¥×10^4 [Yen]
Main unit	700
Storage, power conditioner	2,000
Total	2,700

(b) Biomass thermal and wind power generation

Component	Cost ¥×10^4 [Yen]
Wind	
Main unit	350
Storage, power conditioner	1,000
Biomass thermal	
Main unit	200
Total	1,550

3.3.2 Wind power and biomass thermal generation

If there is enough biomass, such as wood, it may be possible to combine a thermal generator using biomass with wind power generation. Assuming 50% each, the capacity of the biomass turbine generator is required to be 5 kW, and that of the wind power must be about 10 kW. Table 3(b) indicates the estimated cost for this combination [4, 8].

4. Photovoltaic (PV) Power Generation

4.1 Energy statistics in Arab states

According to data from the Arab Union of Electricity [9] and The World Bank [10] (Fig. 5), most Arab states have a reliable energy infrastructure, with the exception of two cases: Iraq and Syria. Those two countries have a low population ratio with access to electricity, despite having a considerably high level of energy consumption per capita. In the case of Yemen and Sudan, the low ratio of population with access to electricity and the low energy consumption may be attributed to their classification as Least Developed Countries by the UN, and thus their lack of an energy infrastructure. Based upon these data, we focus on Iraq and Syria, where investment in new power generation systems would be more likely.

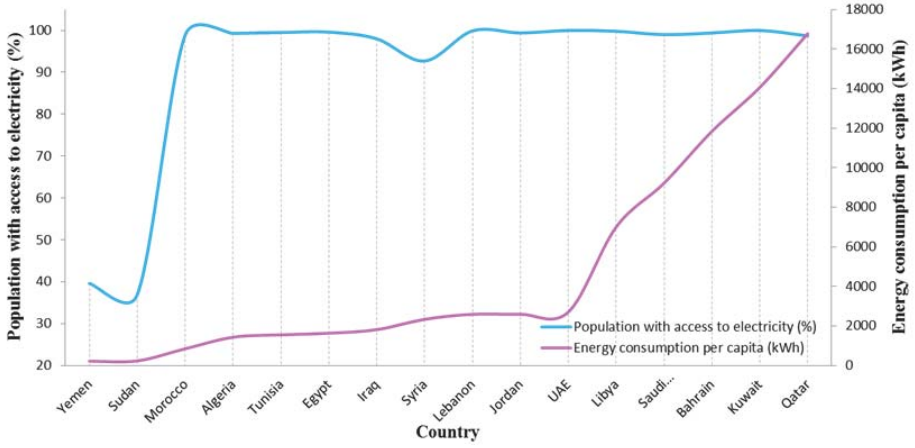


Fig.5 Energy consumption and access to electricity in Arab states.

The major problems regarding electricity distribution involve obtaining fuel and expanding the power network. To provide electricity while avoiding these issues, we must consider implementing renewable energy systems, which can operate independently without the need for fuel.

With regard to the available renewable energies (hydroelectric, wind, solar, and geothermal power), we can see that the geographic locations of Syria and Iraq make them ideal areas to implement solar energy systems (Fig. 6). These systems utilize energy from the sun to produce electricity, thus they can be installed anywhere where sunshine is plentiful, and the problems of fuel availability and dependence on a power grid can be avoided. Commercial solar energy systems can be divided into two basic types: conversion of light into electricity (solar photovoltaics) and conversion of heat into electricity (concentrated solar power). Since solar energy is only available during the daytime, and isolated regions cannot rely on a power grid to obtain backup power, energy storage systems for each of these technologies should also be taken into account.

4.2 Solar photovoltaic power generation

4.2.1 Solar photovoltaics

Solar photovoltaic systems are simple to install and operate. A solar panel is used to convert light from the sun directly into electricity, which can be used immediately. In addition to their easy installation, these systems are advantageous because their capacity can be increased simply by adding more solar panels. The disadvantage of these

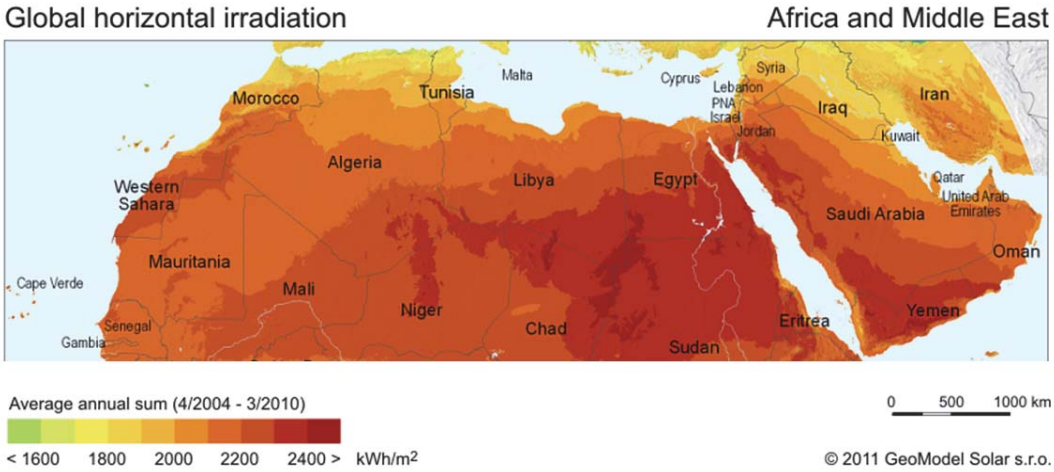


Fig.6 Annual solar irradiation in Africa and the Middle East (map adapted from GeoModel Solar [11]).

systems is that they are more dependent on the climate of the region in which they are used. The electric output of a solar photovoltaic system decreases rapidly as the temperature increases. High temperatures also damage the system's internal components and decrease its lifetime. In the region of Syria and Iraq, high solar irradiance and long exposure to the sun would result in a system with lower efficiency. The energy storage system also presents a disadvantage for solar photovoltaics because the most suitable method for storing electricity involves rechargeable batteries, which degrade quickly when stored at high temperatures.

4.2.2 Concentrated solar power

This type of system collects sunlight over a wide area and redirects it all into one point, concentrating the energy to produce a large amount of heat. This heat is then used to create steam and produce electricity via an electric generator, in the same way that thermal power plants do. In contrast to solar photovoltaics, these systems achieve higher efficiencies at higher temperatures, making them ideal for hot areas such as deserts.

Concentrated solar power systems can be divided into two categories: parabolic trough systems and solar towers. Diagrams for these systems are presented in Fig. 7. In parabolic trough systems, parabolic reflectors are used to redirect sunlight into a central tube carrying a fluid. In solar towers, large mirrors are used to redirect sunlight to a large container at the top of a tower containing oil or molten salts. Both systems utilize a similar power generation process in which heated fluid is used to generate steam and produce electricity through a steam turbine. These types of systems also provide a convenient method for energy storage. The heated fluid can be stored in insulated tanks and reused later to generate electricity at night or in bad weather. When the ambient temperature is high, such as in deserts, energy dissipation is low and storage efficiency increases.

4.3 Required capacity and cost

4.3.1 Power capacity needed in the region

To design an energy infrastructure using solar energy in this region, we first need to know the total energy consumption and the amount of sunshine available. Alnaser et al. provided maps showing the average hours of

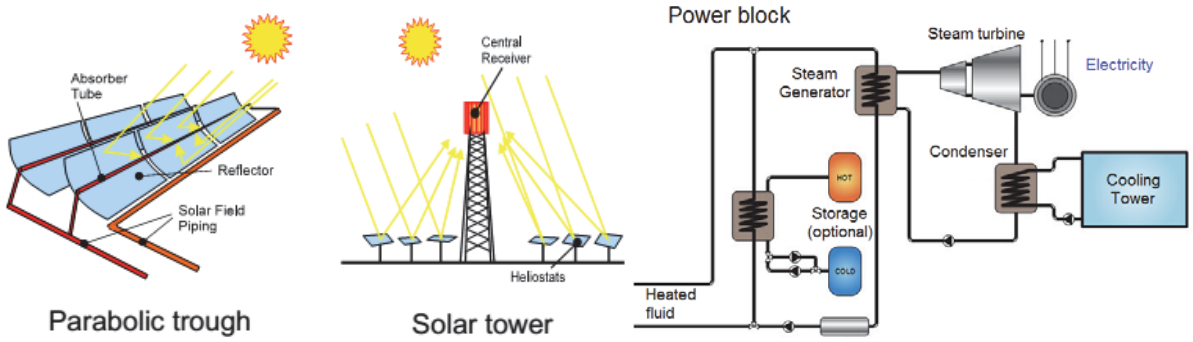


Fig.7 Parabolic and solar tower systems, and the power block used for electricity generation

sunshine per day in Arab states (Fig. 8). In the region of Syria and Iraq (Fig. 5), we can see that the amount of sunshine per day varies from four to seven hours in January, to twelve hours in August. The long sun exposure in August and the large amount of storage needed for January suggest that concentrated solar power is the best choice for power generation. Based upon the data from Fig. 5, and the amount of sunshine available, we can see that a 50 kW power generation system with energy storage would be needed to fully supply electricity to a community of 100 people. The designed system should be competitive with Syria's energy price of 14 cents (USD)/kWh.

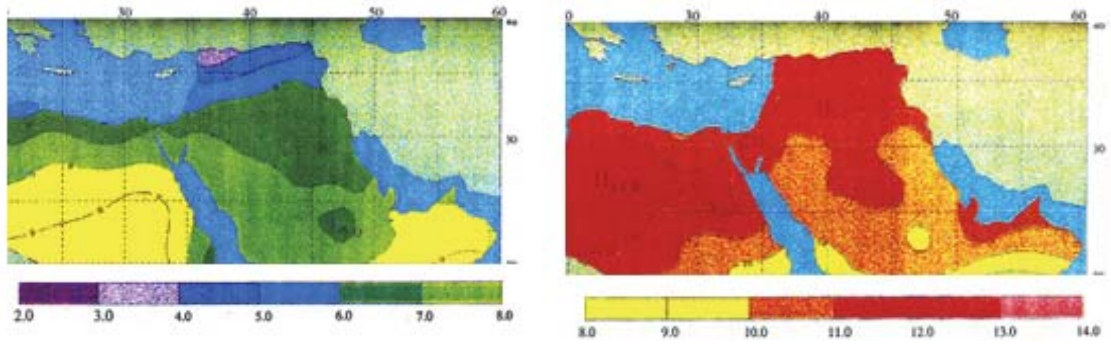


Fig.8 Average hours of sunshine per day in January and August (map adapted from Alnaser et al., 2004).

4.4 Cost estimation

The cost of PV solar power generation is still very high, particularly the cost of a power conditioner. Based on data regarding PV solar power generation in Japan [4], we obtain the following estimated cost for 10 kW generation:

PV solar generation system: 10 million Yen

Power conditioner for 30 kWh: 20 million Yen

Total: 30 million Yen for 10 kW

5. Conclusion

Based on the investigation, we conclude the following:

(i) If there is enough rainfall and thus a sufficient water flow, a small hydraulic turbine generator is the most promising way to generate power. Hydraulic power generation is the most efficient method, and it is the most reliable

provided that there is a continuous water flow. The estimated cost of a 10 kW hydraulic generator station is less than 15 million Japanese Yen. In addition, this system is easiest to maintain and it has the longest lifetime.

(ii) Along a seacoast and on an island, wind power generation is the best choice because of the continuous winds that are present there, with an average speed higher than 5 m/s. However, based on the working ratio, the capacity of a wind turbine generator would have to be about 20 kW to assume a generating capacity of 10 kW. This costs about 7 million Japanese Yen. However, if an electricity storage system is installed together with a power conditioner, taking into account the wind fluctuation and thus the output power fluctuation, the cost increases by an additional 20 million Japanese Yen.

(iii) In an area where the average amount of sun is high enough annually, such as an African desert, photovoltaic solar electricity generation is the best choice. However, it requires storage (battery) and a power conditioner to supply reliable electricity. Also, aging (lifetime) and maintenance become big problems due to sand dust, and also because the daily temperature can fluctuate by 15‐20 °C. As with wind power, the capacity of a photovoltaic solar generator necessitates about 20 kW. The estimated cost of a 20 kW photovoltaic solar panel is about 10 million Japanese Yen, and a 30 kWh storage system costs about 20 million Japanese Yen.

(iv) Based on information regarding power generation in Japan, the following costs per kW can be applied to a small-scale power generation system:

(a) Hydraulic: 1–1.5 million Yen (b) bio-thermal: 0.4 million Yen

(c) wind: 0.35 million Yen (d) solar: 0.7 million Yen.

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Forgiveness Brokers: Assessing the Role of Foreign Actors in Libyan Reconciliation

Nikolay Shevchenko

Reconciliation encompasses a variety of problems and issues, often diverse in nature. One division related to the theory of reconciliation lies between interstate and intrastate reconciliation practices. In some cases, the process of reconciliation among different nations and people of a single nation may be similar to some degree. However, theory and practice of reconciliation draw clear a line between the two when considering the potential role of foreign players in interstate and intrastate reconciliation. A commonly articulated position of reconciliation experts and practitioners holds that while international actors may have a substantial effect on the mediation of international conflicts and the subsequent reconciliation process among nations, their role in intrastate reconciliation is rather limited. This paper outlines a preliminary assessment of international actors' role in intrastate reconciliation through the observation of reconciliation attempts in a post-conflict Libya. The goal is to gain a deep understanding of potential contributions as well as limitations, of foreign actors' attempts to assist post-conflict societies in need of reconciliation.

Key words: reconciliation, international community, foreign actors, civil war, Libya.

Introduction

Current reconciliation literature does not dedicate enough attention to role of foreign actors in intrastate reconciliation practices. It is commonly thought that the actors who are directly affected by initiatives and programs concerning reconciliation should lead them. When considering intrastate conflicts, foreign actors are eliminated from this category as they might propose different initiatives, but the genuine practice of reconciliation is considered to be an internal issue of a state in question. This paper analyzes a situation in post-conflict Libya to demonstrate that this theoretical assumption is not reflected in practice.

A number of foreign actors sought active roles in promoting reconciliation initiatives in post-conflict Libya, including international, intergovernmental, and non-governmental organizations. Contrary to the notion that foreign actors should play a minimal role in intrastate reconciliation practices, these entities sought an active role in the Libyan post-war reconciliation efforts. This active engagement not only questions a general assumption of literature on reconciliation, but also undermines one of the most important features of reconciliation – the neutrality of its brokers. In the first part of this paper, I attempt to explore why the role of foreign actors is typically neglected in literature on intrastate reconciliation. The second part uses the example of Libyan reconciliation to demonstrate why foreign actors deserve more attention in this regard. I finally conclude with posing a question of neutrality regarding foreign actors playing a role in reconciliation after intrastate conflicts.

Foreign Actors and Reconciliation

Reconciliation resembles a kaleidoscope. This may seem a rather irresponsible comparison to the professional eye of a practitioner or scholar, but nothing truer has been said about reconciliation. In the end, reconciliation is a perplexing mix of causes, purposes, objects, tools, and actors, all mixed in a colorful, but strange, difficult to conceptualize picture of multiple levels and incarcerated into a single term.

Various reasons can bring reconciliation to mind, be it quarreling with a neighbor over a minor issue, or a war breaking out. Reconciliation may be mentioned as a remedy to cure wounds inflicted by numerous and diverse causes. It is deemed vital for decreasing hostilities, preventing violence, bridging antagonists, and living together peacefully, even while the causes of antagonism may vary widely.

Some people question whether reconciliation is useful for addressing international conflicts. Successful reintegration of Germany into the society following their defeat in World War II and their current peaceful relations with former enemies illustrates how fruitful successful reconciliation can be, even following deadly international conflicts. Another question is whether reconciliation is helpful for

addressing injustices inflicted upon one group in a given society by another. Many states, including the United States, have set a precedent. A number of cases have proven that reconciliation can assist in forming alliances between former belligerents or criminals, and their victims. Whether interstate or intrastate conflict, mass human rights violations, civil wars, fall of dictatorships, or discrimination of minorities, people tend to regard reconciliation with a hope of solving problems of the past and constructing a peaceful future.

People have expectations of many goals to be achieved if reconciliation is practiced properly. However, this topic is more interesting than the one of causes because different views on reconciliation may favor different sets of goals that reconciliation is to achieve. This is where the perplexity of reconciliation develops. Depending on personal judgments, reconciliation might be perceived as either seeking to reestablish justice or to promote political and social peace, even at the expense of the former. Of course, the latter's objective inevitably involves the existence of a just order which makes past injustices irrelevant; but the question of retribution remains.

People undergoing the process of reconciliation often have to choose between punishing abusers and perpetrators of crimes and acknowledging victims' sufferings. The two theoretical ends represent a fundamental practical choice between justice and peace, as the goals may be contradictory. The basic choice is between victim-focused or perpetrator-focused reconciliation.[1] Victim-focused reconciliation may fail to punish perpetrators of past crimes or to address victims' emotions of anger and resentment. Perpetrator-focused practice of reconciliation may fail to secure a place for large groups of people in the future socio-political structure of a state and cause a problem of revenge.[2]

This brings the discussion to tools of reconciliation. In other words, what are the practical instruments, approaches, and techniques to conduct a successful practice of reconciliation? The answer will essentially depend on successfully resolving the goal dilemma described in the previous paragraph. There are multiple tools; each brings people toward a different outcome. A broad spectrum of tools available to address injustices begins with the dangerous practice of revenge and ends at a mild gesture of forgiveness; while in between there lie retributive and restorative faces of justice.[3] The tools of this spectrum are institutionalized in different ways. Attempt to restore justice may be exercised by punishing perpetrators of past injustices through trials in courts. However, if the goal is to acknowledge victims while, at the same time, integrating perpetrators in the future order, truth and reconciliation commissions, so widely practiced now, promise a higher probability of success. Both have been widely practiced and will continue to be practiced in the future. The former tool, for example, was utilized in Yugoslavia and Rwanda, and the latter in South Africa and more than 25

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[1] Daniel Philpott, "An Ethics of Political Reconciliation," *Ethics and International Affairs*, 23(4), (2009): 389–407.
[2] Ibid.
[3] Joel H. Rosenthal, entry on "Making Peace: Dilemmas of Reconciliation," Carnegie Council for Ethics in International Affairs Website, entry posted on April 10, 2001, http://www.carnegiecouncil.org/people/data/joel_h__rosenthal.html (accessed April 10, 2001).

states worldwide.[4] Reconciliation is a kaleidoscope of causes, goals, and tools united in a single picture that easily changes its form and appearance.

While observing the complex interplay of factors that shape the practices of reconciliation, it is especially puzzling to understand literature's modest silence regarding actors of reconciliation. One should avoid misreading the claim: it is fairly easy to distinguish between two persons reconciling their minor divergences, between fractions within a single society broken by a civil war, or between two separate states reconciling after an international conflict. It is more difficult, however, to identify third parties and their participation in bringing conflicting elements towards reconciliation. Drawing from observations on post-civil war attempts at reconciliation in Libya, this paper aims to make a preliminary assessment of the potential effects of involvement of third parties into reconciliation among fractions in war-torn societies and of their potential contributions and limitations in this uneasy undertaking.

To be fair, the literature does examine third parties and their roles in conflict management and reconciliation. However, it focuses on the international realm, effectively restricting the question in its relation to domestic sphere.

The role of third parties in the management of international conflicts has traditionally been quite extensive, as have the methods of external-driven attempts to reconcile hostile parties, returning them to a condition of mutual trust and potential cooperation. In his review on the involvement of third parties in international conflicts, Ronald J. Fisher defines six categories of intermediary practices available at their disposal, including *conciliation*, that refers to provision of "... an informal communication link between or among the antagonists..." by a trusted third party; *mediation*, that involves a more decisive involvement of a third party which might use leverage or coercion as a mean to reconcile conflicting actors; *arbitration*, that include a binding judgment issued by a third party; *consultation*, which refers to a more scientific approach to reconciliation that includes conflict analysis and alternative scenario development "... through communication and diagnosis based on social-scientific understanding;" and, finally, a category of *peacekeeping*, that "involves the provision of military personnel by an outside party to supervise and monitor a cease-fire between antagonists."[5]

Although Fisher acknowledges these possible scenarios of foreign assistance in instances of conflict mediation and reconciliation, he admits that they, as well as the tools and techniques they provide, are largely limited to the international level conflicts and leave the domestic realm with fewer options for third party involvement.[6] It is possible to explain this theoretical reduction to international sphere by examining a certain conceptualization of conflict roots. If one assumes that violent conflicts occur because of misperceptions and miscommunications between two or more actors who may not be willing to use force to achieve their ends under different circumstances, the emphasis on the role of neutral mediators is explainable since they can potentially

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[4] Joanna R. Quinn, introduction to *Reconciliation(s): Transitional Justice in Postconflict Societies*, ed. Joanna R. Quinn (Mc-Gill-Queen's University Press, 2009), 3–13.

[5] Ronald J. Fisher, "Pacific, Impartial Third Party Intervention in International Conflict: A Review and an Analysis," in *Beyond Confrontation: Learning Conflict Resolution in the Post-Cold War Era*, ed. John A. Vasquez, James Turner Johnson, Sanford Jaffe, and Linda Stamato (The University of Michigan Press, 1995), 40–1.

[6] Ibid. 39.

reconcile foes by the intermediary practices mentioned above. Those studying the root causes of intrastate conflicts, however, must often seek a different explanation of their outbreaks as these conflicts typically result from "the incompatible positions two or more parties have taken on issues that represent the core values of a regime and/or society."[7] The conclusion of a civil war is critical to all participants; it determines the shape of the future social, political, and economic order. Intrastate wars imply an extreme form of incompatibility in the values and goals of different parties cursed to live under a single roof; the incompatibility of desired outcomes that are binding for all participants explains why it is more difficult for foreign actors to practice meditation and reconciliation in instances of intrastate conflicts as opposed to interstate ones.

An alternative view on the potential impacts of third parties on conflict management and reconciliation stresses that it is essential to take into account the complex dynamics of interplay between international factors, attempts of third parties to provide international assistance, and domestic factors in recipient states. Shiping Tang, for example, reviews a number of international and domestic factors when assessing their degree of success in attempts at reconciliation between sovereign states. His analysis stresses the importance of domestic factors such as "... regime type, regime security, social cohesion (at both elite and public levels), and leaders' preferences" in their relation to such international factors as "... distribution of power, coalitions of regimes within a region, the presence or absence of an external power, the presence of regional organizations, regional identities, and global norms (for example, human rights after WWII)" in successful reconciliation practices.[8] Although his analysis concerns conflicts and reconciliation on an international level, this is to say between sovereign states, it nonetheless provides a useful insight into the framework of domestic factors shaping practices of reconciliation and the broader practice of conflict management.

Analyses concerning reconciliation in cases of interstate conflicts are important when taking into account that violent outbreaks often occur in international system. There are no intermediaries other than states themselves in these instances. Moreover, taking into consideration the current level of globalization resulting in an increasing degree of mutual interdependence, interstate conflicts in the most remote parts of the world may present a threat to those states that may not directly be involved in hostilities. In this respect, the relative abundance of tools available to third parties when attempting to reconcile two or more hostile peers is understandable. However, one should not forget that intrastate conflicts dominate the current system of international relations.

Most conflicts in the post-World War II era have started internally and in some cases led to international involvement.[9] Therefore, over the past millennium, and especially following the Cold War, states and international organizations have become more sensitive to intrastate conflicts occurring inside sovereign countries. Again, due to actors' current interdependence in the international system, violence occurring in a third country would certainly have an impact on the national interests and security of other states. Some may be affected by the flow of refugees escaping conflicts, while others may have concerns about the security and balance of power in a region where a conflict

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[7] J.K. Holsti, "Paths to Peace: Theories of Conflict Resolution and Realities of International Politics," in *International Conflict Resolution*, ed. Ramesh Thakur (Colorado: Westview Press, 1988), 112.
[8] Shiping Tang, "Reconciliation and The Remaking of Anarchy," World Politics 63(4), (2011): 732.
[9] Adrian Guelke, "Force, Intervention and Internal Conflict," in *The Use of Force in International Relations*, ed. F. S. Northedge (Faber and Faber Limited, 1974), 99.

takes place; some may worry about the involvement of their rivals in a conflict and others may simply be interested in one party's victory over another.

In this respect, outside interference into intrastate conflicts is a well-known phenomenon, and although some may oppose it, the trend remains. Foreign actors tend to enter into domestic conflicts of sovereign states. Typically, those parties fight for redistribution of economic resources within the borders of their own state or for reshaping of the state's political landscape; or sometimes for both. Still, although these conflicts are purely domestic at their roots, foreign influence always affects events on the ground, shifting balance, or assisting in resolving tensions. The role of foreign actors in intrastate conflicts may not necessarily result in direct military intervention, but it encompasses a number of actions, such as issuing statements condemning one side or the other, supporting one party or the other, facilitating dialogue between foes, etc. Inevitably, these aspects of external interferences influence the development of domestic conflicts and relations between conflicting parties. Hence, all instances of external influence have their own effect on potential reconciliation between former foes when a conflict ends. This self-evident point has not been properly addressed with regard to reconciliation. The role of the international community may be acknowledged in such spheres as peace-building and peace-keeping while the question of reconciliation remains in shadow. One may assume that peace building efforts could include reconciliation as well, but this view is not accurate. When it comes to reconciliation between former foes in a period of constructing a new political and economic order prior to a conflict, it has been said "... we must be modest about the role of the international community."[10] The following part of the paper is an overview of the Libyan civil war, the attempts for reconciliation in the aftermath of the conflict, and the impact of foreign actors on these attempts.

Reconciliation in Libya

Libya is one of the most illustrative situations where reconciliation is urgently required but problematic to achieve. It is almost impossible to agree on a successful approach to reconciliation in a condition where lack of trust, even mutual hatred, is still vivid among former foes.

The notorious civil wars in the Arab World began with a wave of unrest sparked in Libya, where people have been living under Gaddafi's regime for more than 40 years, in what has since become known as the Arab Spring. The unrest in Libya, following a wave of a broader unrest in the Middle East, began in mid-February 2011 with protests breaking out in Benghazi. They quickly spread to eastern cities of Libya and after several days, the protests moved west with the first clashes between protesters and governmental forces. Soon, the anti-government protesters reached the Tripoli, the capital city of Libya. Around this time, the anti-government forces claimed control over some cities located in the east of the country, including Benghazi.[11]

The week of February 23 to February 27 was considered the first breaking point in the Libyan turmoil when the anti-governmental forces claimed control over the

[10] Enrique Sanchez, Sylvia Rognvik, "Building Just Societies: Reconciliation in Transnational Settings" (Workshop report prepared by the United Nations Organization, Accra, Ghana, June 5–6, 2012).
[11] Jeremy Bowen, "Libya: The Fall of Gaddafi," BBC News Africa Website, http://www.bbc.co.uk/news/world-africa-13860458.

eastern part of Libya and the largest presence of police, military, and other security forces is reported in Tripoli. At the same time, the rebels began clashing with pro-governmental forces loyal to Gaddafi over control of several cities. Eventually the rebels began to claim control of more cities than the Gaddafi's government and the protests against the government turned into a full-fledged civil war between those forces supporting an old Gaddafi regime and those fighting to overthrow it.[12]

Since the beginning of the protests, foreign actors exercised a degree of involvement, which grew as time passed and events on the ground developed. These attempts culminated into United Nations (UN) Security Council (UNSC) resolution number 1973 that authorized enforcement of a no-fly zone over the territory of Libya as well as implementation of "all necessary measures" to protect the civilian population of Libya.[13] This UN Security Council resolution culminated into air strikes against pro-Gaddafi forces and installations by France, the United Kingdom, and the United States.[14] With the eventual help of foreign actors, the National Transitional Council (NTC) of rebels achieved a number of a decisive victory.[15] The civil war was over but new problems arose.

Although the long and bloody conflict had ended, there were a number of urgent issues to be addressed by the NTC in the post-conflict environment with the reconciliation standing out. The task of addressing and eventually reconciling with the past is extremely difficult for post-conflict societies for a number of reasons. First, one of the major tasks of post-conflict states is to build a new political, social, and economic order different from the previous one, and that would take into account the roots and outcomes of the conflict. Second, it is difficult for the winning side not to fall into the trap of “victors’ justice.” The task of reintegrating your former foes into the new order of the future is demanding yet vital for the peaceful development of a state. Third, the question of refugees must be addressed, particularly if there are hesitations on behalf of refugees to return home for fears that they will prosecuted under a new regime. In the Libyan scenario, these problems became apparent following the end of the civil war.

After the open hostilities, there were significant obstacles for the Libyan government to construct a new, stable, and peaceful order. For example, as previously mentioned, the people of a new Libya had to deal with the risk of recurring authoritarianism, which a number of revolutions in the past clearly demonstrated. In any revolution there are risks of changing one authoritarian regime to another. People in many countries suffer enormously only to find themselves trapped in the same authoritarian setting that was in place prior to the revolution. Of course, this is one of the most important aspects of reconciliation: ensuring that a winning fraction does not impose authoritarian rule over other groups within a state's borders; Libya is not an exception, it only reinforces this conventional wisdom. In fact, the return of authoritarianism following the civil war is a major risk for new political order in Libya. A number of factors contribute to fears of recurring authoritarianism in the Libyan case,

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[12] Ibid.
[13] Department of Public Information, "Security Council Approves 'No-Fly Zone' over Libya, Authorizing All Necessary Measures to Protect Civilians, by Vote of 10 in Favor with 5 Abstentions," United Nations Security Council, http://www.un.org/News/Press/docs/2011/sc10200.doc.htm.
[14] Jeremy Bowen, "Libya: The Fall of Gaddafi," BBC News Africa Website, http://www.bbc.co.uk/news/world-africa-13860458.
[15] Ibid.

including on-going human rights violations, ineffectiveness of judicial sector, internal fragmentation of a state, and dissatisfaction with the central authority.[16] Karim Mezran, a senior fellow with the Atlantic Council's Rafik Hariri Center for Middle East, warns that with many people, former supporters of the Gaddafi regime, being "... in jails without a trial, limited access to a lawyer, and in unknown physical condition, [...] the state of Libya risks implosion or a return to authoritarianism [...] [i]f a strong initiative is not undertaken rapidly by the Libyan government and its Western allies."[17]

Moreover, constructors of a new political system in Libya intentionally marginalize Gaddafi-era officials, as well as those who opposed the revolution, from holding public offices and actively participating political life. As Human Rights Watch reports, in May of 2013, Libya's Parliament passed a "Political Isolation Law," that "... bans members of various groups from working in 20 categories of public service." "Some of the excluded groups," the report says, "are fairly clearly defined, such as former senior officials under Gaddafi, but others are much vaguer, such as those judged to have shown a "hostile attitude toward the February 17 revolution." The law even bans those who held office under Gaddafi but defected from him years ago or during the uprising and war that ended in his fall."[18] What is even more alarming for the process of reconciliation in Libya is that the Libyan parliament has "... attempted to 'immunize' the law from review by the highest court in Libya, to see if it complies with human rights."[19]

This situation is typical one for a state that has only recently been torn to pieces by hostile fractions, each fighting for their own political goals and agendas. Since the NTC proved victorious in the revolution, it may appear natural that its members and their supporters would use this fact to boost their influence and legitimacy in the eyes of the Libyan people. However, this leads to problems of recurring authoritarianism and of marginalization of a large part of political strata. As a report of Chatham House on Libya rightly underlines, "the key question [for Libya now] is not who is *in* the government but who is *out* of the government,"[20] for any illegitimate exclusion of some groups from a future political life of the country bears risks of recurring authoritarianism. The problem for Libya, though, is that at least "at present individual political legitimacy is drawn from the role one played in the revolution, preventing the development of fully democratic representation."[21] This presents one of the major challenges to national reconciliation and construction in a newly inclusive socio-political order.

An additional reason in favor of a dedicated approach towards reconciliation in Libya is Libyan refugees in other countries. Wars force people out of their states in a search of better and safer lives. However, this is only the surface of other problems

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[16] Karim Mezran, "Insight: Libya Needs National Reconciliation, Not Retribution," Middle East Voices, http://middleeastvoices.voanews.com/2013/04/insight-libya-needs-national-reconciliation-not-retribution-81623/.
[17] Ibid.
[18] Tamara Alrifai, "Learning a Lesson from Libya & Iraq: Reconciliation, Not Revenge," Human Rights Watch, http://www.hrw.org/news/2013/05/29/learning-lesson-libya-and-iraq-reconciliation-not-revenge-0.
[19] Ibid.
[20] Libya Working Group Report: MENA Programme, "Challenges after Liberation," Chatham House Working Report, http://www.chathamhouse.org/sites/default/files/public/Research/Middle%20East/231111libya.pdf.
[21] Ibid.

related to reconciliation and it appears much deeper if one recognizes the unwillingness of the refugees to return to their homes following hostilities because they are afraid of being prosecuted by new authorities. This kind of situation challenges not only the further development of the state, but can potentially deteriorate its relationship with neighbors for whom the issue of political refugees becomes significant. This scenario is apparent in Libya.

It is estimated that up to one million Libyan refugees now live in countries bordering Libya, mainly in Egypt and Tunisia. Taken together, these refugees account for up to 20 percent of the Libyan population.[22] Obviously, such a large population cannot be excluded from the country's political life. At the same time, most of them are unwilling to return to Libya for fears of revenge and unfair trials in conditions of weak security of a post-war Libya. The issue of Libyan refugees particularly affected Egypt, where around 800,000 Libyans found their refuge. This makes Egyptian authorities interested in the progress of a national reconciliation program in Libya.[23] As Karim Mezran writes, "Libyan authorities have assured the Egyptian government that they will protect the extradited individuals, guarantee a fair trial, and provide all protections sanctioned under international law, yet it is questionable whether they can actually deliver on this promise given that government officials themselves face significant security threats."[24] The Libyan refugees currently living in neighboring countries, and the new government's apparent inability to successfully address and solve this problem, constituted yet another reason for the Libyan government to dedicate further efforts toward national reconciliation in their country.

Injustices created by the Libyan civil war crystallized in the uneasy relationship between the two cities: Misrata and Tawergha. A circle of revenge that affected residents of the two cities highlights the disastrous potential of the failed process of reconciliation in post-conflict states. During the civil war, Misrata was a hot spot where some key fights took place and where its residents suffered from torture and abuse from pro-Gaddafi forces. After the pendulum of civil war changed direction and rebel forces initiated an offensive, the population of Tawergha, with its predominantly black Libyans, suffered revenge from their former victims.[25] The cycle of violence and revenge recurring among the people of these two cities illustrates how easily roles can change in a conflict and how former victims can become abusers. A UN report on transitional justice in Libya highlights importance of this fact: "In some cases perpetrators of past crimes became victims, while victims also became perpetrators."[26] Persistent and dedicated attempts for a nation-wide reconciliation attempt to

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[22] Karim Mezran, "Opinion: Yet Another Reason National Reconciliation in Libya Cannot Wait," Libya Herald, http://www.libyaherald.com/2013/01/27/opinion-yet-another-reason-national-reconciliation-in-libya-cannot-wait/#axzz2hz4ubPt8.

[23] Karim Mezran, "Insight: Libya Needs National Reconciliation, Not Retribution," Middle East Voices, http://middleeastvoices.voanews.com/2013/04/insight-libya-needs-national-reconciliation-not-retribution-81623/.

[24] Ibid.

[25] Ashraf Mashharawi, "The Road to Tawergha," AlJazeera Documentary, http://www.aljazeera.com/programmes/aljazeeraworld/2013/10/road-tawergha-201310191859343221.html.

[26] United Nations Support Mission in Libya, "Transitional Justice - Foundation for a New Libya," United Nations, http://www.unsmil.unmissions.org/LinkClick.aspx?fileticket=8XrRUO-sXBs%3D&tabid=3543&language=en-US.

eliminate this type of hostilities because it is impossible to build a healthy and functional society where feelings of hatred predominate between different cities, regions, fractions, groups.

Challenges of recurring authoritarianism, internal fragmentation of state, and refugees are the reasons for conducting a process of national reconciliation in Libya between the associates of the former regime and those currently in power. Due to a number of reasons discussed above, successful reconciliation may determine a degree of stability in the future Libyan political and social conditions. However, security conditions in Libya, its ability to approach reconciliation in the country as well as stability of it socio-political order must be of interest not only to Libyan public and its political authorities, but also to a wider international community of states. There are a number of reasons for this.

First, the issue of political exiles unable to return to Libya due to its new government's failure to provide them with security guarantees and its inability to effectively conduct a process of national reconciliation may potentially lead to the political destabilization of Libya and, consequently, of the wider region. The issue appears sharper if one considers the possible effect on al-Qaida in the Islamic Maghreb and related extremist organizations.[27]

Second, because Libya is largely perceived as a strong historical precedent with regard to its impact on the Syrian civil war, failure of the international community to ensure effective reconciliation practice in Libya may negatively affect the current state of affairs in a conflict-torn Syria. As one expert explains, "with the Libya experience as a guide, abandoning Assad will look increasingly unattractive to his supporters."[28]

Third, with a complicated interplay of international and domestic actors' interests and agendas, the Libyan case may be a future model that will determine a potential role for representatives of the international community in national reconciliation efforts. In this respect, the Libyan case might be an opportunity for international actors to develop more effective international tools for influencing and facilitating reconciliation processes in post-conflict states.

Thus far, a number of international players have been assuming various roles in Libyan reconciliation. These players included sovereign states, international organizations, as well as representatives of a broader civil society and non-governmental organizations.

One of the most recognized international contributors to reconciliation in Libya was the International Criminal Court (ICC) that has been dealing with the conflict since the beginning. The Libyan case was referred to the ICC in February 2011 by the UNSC after it adopted resolution number 1970 that said, "the Libyan authorities shall cooperate fully with and provide any necessary assistance to the Court and the Prosecutor pursuant to this resolution."[29] Subsequently, the ICC has begun its investigation of the Libyan

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[27] Karim Mezran, "Insight: Libya Needs National Reconciliation, Not Retribution," Middle East Voices, http://middleeastvoices.voanews.com/2013/04/insight-libya-needs-national-reconciliation-not-retribution-81623/.

[28] Ibid.

[29] Press Release, "Pre-Trial Chamber Issues Three Warrants of Arrest for Muammar Gaddafi, Saif Al-Islam Gaddafi and Abdualla Al-Senussi," International Criminal Court Website, http://web.archive.org/web/20111126013502/http://www.icc-cpi.int/NR/exeres/D07229DE-4E3D-45BC-8CB1-F5DAF8370218.htm.

case and soon after, in June 2011, the organization issued three arrest warrants: for the Libyan ruler Muammar Gaddafi, his son Saif al-Islam Gaddafi, and Abdullah Senussi, head of Libyan intelligence service, on charges of crimes against humanity.[30] The case against Muammar Gaddafi was eventually terminated due to his death; the other cases remain open.

In this respect, one of the most important contributions to the Libyan reconciliation by the ICC would be to ensure a fair trial for the two associates of the former regime. Therefore, the choice of location for the trials is vital - the choice between The Hague and Libya is going to have an impact on the future of the Libyan reconciliation. In this light, the recent decision of the ICC to refuse to demand the former intelligence chief, Abdullah Senussi, to be tried in The Hague is of particular interest.[31] This decision most likely implies that Abdullah Senussi will be tried in Libya by the new regime.

The decision is a result of different factors. First, as a BBC analyst Rana Jawad has explained, the new Libyan government had no initial intention to deliver its former intelligence chief or Gaddafi's son to The Hague in the first place.[32] In this respect, the ICC could not demand the two men to face the trial in The Hague. At the same time, the decision of the ICC had a symbolic effect of recognition of the Libyan judicial system's credibility. It could be seen as an expression of trust in ability of a new Libya to organize and conduct fair trials articulated by the respectful international body. This, in its turn, boosts external legitimacy of the new Libyan regime.

However, this choice, on behalf of the ICC, may lead to negative consequences, depending on the conduct and results of the trials. A major concern is that the new Libyan regime may fail to guarantee a fair trial for the two associates of the former rule. In this case, the major risk is that the trials may turn into “mob's justice.” A lawyer of the former Libyan intelligence chief has already raised these concerns commenting on the ICC decision. He claimed, "... the Libyan justice system is in a state of collapse and ... it is incapable of conducting fair trials of any Gaddafi-era officials”; and that the ICC decision will "condemn Mr. Senussi to face mob justice without even access to a lawyer, and in which the inevitable outcome is the death penalty."[33] If events develop according to this scenario, it will inevitably have an overall negative impact on a nationwide reconciliation in a post-war Libya.

Reconciliation is not only about punishing the perpetrators of crimes and acknowledging their victims in judicial courts. First, reconciliation is about healing the past traumas, forgiving abusers, learning how to live peacefully with them, and overcoming a moral, sensual divide that is decisively drawn by wars, revolutions, or any other catastrophes. For this very purpose, which may appear less tangible then transitional justice but which happens to be much more influential in constructing a future order, trials may not be as effective, even if conducted in a fair manner. What is needed instead is formal and informal cooperation between former foes on different

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[30] Ibid.
[31] "Gaddafi-Era Spy Chief al-Senussi to be tried in Libya," BBC Africa News Website, http://www.bbc.co.uk/news/world-africa-24493885.
[32] Rana Jawad, "Analysis," BBC Africa News Website, http://www.bbc.co.uk/news/world-africa-24493885.
[33] "Gaddafi-Era Spy Chief al-Senussi to be tried in Libya," BBC Africa News Website, http://www.bbc.co.uk/news/world-africa-24493885.

levels of social structure that will ensure former antagonists have a common goal to work towards on the condition of trust and cooperation.

It is for this purpose that the participation of national and international Non-Governmental Organizations (NGOs) is important. Muzaffer Ercan Yılmaz, an advisor at the International Middle East Peace Research Center, outlines a clear role of international and domestic NGOs in "track-two diplomacy," a practice aimed at bridging hostile to pursue a common goal. Building on Montville's research, he explains that, "one way to ease relational problems and build trust among hostile groups would be track-two diplomacy. Track-two diplomacy is an unofficial, informal interaction between members of adversary groups aiming to develop strategies, influence public opinion, and organize human and material resources in ways that might help resolve their conflict."[34] These informal interactions and practices may help conflicting parties when addressing the root causes of their antagonism and when working together to find ways to overcome the causes and move forward, leaving behind a negative psychologically constructed image of their former foes.[35] For this less official approach to national reconciliation, though hardly less effective, a role of international facilitators and organizers in the face of NGOs must not be underestimated.

One of the most notorious examples of this initiative in practice in Libya was the Italian NGO Ara Pacis. With support of the Ministry of Foreign Affairs of Italy and in close cooperation with a number of Libyan NGOs as well as academic institution Ara Pacis has launched a program aimed at encouraging reconciliation among Libyan people called “The Libya Initiative.”[36] The purpose of this initiative was to develop, implement, and facilitate a path towards reconciliation by working with civil society in Libya.[37] Incorporating a number of governmental and non-governmental institutions, universities, and NGOs, the initiative provided an example of the role of NGOs-driven efforts to facilitate reconciliation in post-conflict states. It is only unfortunate that the role of other similar initiatives was not well known in the Libyan case, although potentially they constitute a strong contribution to success of the national reconciliation.

Another type of foreign factor active in Libyan reconciliation was represented by supranational organizations. Arguably, the United Nations is the most influential player in this respect with its involvement in preparing Libyan reconciliation beginning during the civil war. In August 2011, UN Secretary General, Ban Ki-Moon, emphasized the need for preparing for a post-conflict reconciliation to the leader of NTC, Mustafa Abdul-Jalil.[38] Later, the United Nations Security Council has authorized the UN to launch the “United Nations Support Mission in Libya” (UNSMIL) by passing

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[34] Muzaffer Ercan Yilmaz, "Peace Building in Libya," International Middle East Peace Research Institute, http://www.impr.org.tr/en/peace-building-in-libya/#.UpxZ4cRDtIE.
[35] Ibid.
[36] "Towards Healing and Reconciliation: The Libya Initiative Launched," Libya Herald, http://www.libyaherald.com/2013/05/04/towards-healing-and-reconciliation-libya-initiative-launched/#axzz2hz4ubPt8.
[37] Council for Dignity, Forgiveness, Justice and Reconciliation, “The Libya Initiative," Ara Pacis Website, http://www.arapacisinitiative.org/it/component/content/article/369 (accessed December 1, 2013).
[38] UN News Center, "Libya: UN Chief Stresses Unity and National Reconciliation During Transition," United Nations Website, http://www.un.org/apps/news/story.asp/html/realfile/story.asp?NewsID=39365&Cr=libya&Cr1=#.Upx2eMRDtIE (accessed December 1, 2013).

a resolution number 2040 in March 2012.[39] This resolution marked the beginning of a heavy UN involvement into the reconciliation process in Libya.[40] The mission's mandate was broad and included other spheres beyond reconciliation, but nevertheless, dedicated efforts to national reconciliation in Libya have been undertaken under the mandate of the mission. In particular, the mission's role in strengthening and promoting reconciliation in Libya has been undertaken through assistance it provided the new Libyan government with, including in strengthening its justice system, protecting human rights, and fostering domestic-driven reconciliation efforts.[41] In December 2012, the UNSMIL was the major force behind an international conference on reconciliation in Libya that provided a platform for representatives of governments, civil society, and international community to discuss prospects and obstacles towards reconciliation in the post-conflict state. With nearly "... one hundred Government officials, members of the Fact-Finding and Reconciliation Commission, members of the General National Congress, members of the Council of Wise Men (Hukama), representatives from the Ministry of Martyrs and Missing Persons, civil society and victim groups, and individual experts as well as members from the diplomatic community," the UN-led initiative had a huge impact on facilitating debates on Libyan reconciliation, underlying its problems and seeking solutions.[42] Undoubtedly, large international organizations, such as the United Nations, possess a spectrum of opportunities to contribute to a national reconciliation in post-conflict states due to their budget, connections, organizational power, and prestige and credence that they enjoy internationally.

The European Union (EU) was another foreign actor whose activities aimed at supporting post-war reconciliation efforts in Libya. In general, the EU was closely following the development of the crisis in the African state. A number of EU countries contributed their assets to the NATO operation in Libya. Consequently, reconciliation is seen by the EU officials as one of the aspects of post-war reconstruction for which the EU may contribute positively. For example, Nicolas Sarkozy, then serving as a President of France, has emphasized the need for reconciliation and forgiveness in Libya.[43] In the aftermath of the war, reconciliation and transitional justice constitute an important part of the EU's efforts to oversee the Libyan power transition and stabilization in the country. Thus far, the EU has been working in cooperation with the new Libyan government to implement programs strengthening Libya's institutions, rule of law, and work of judicial sector, in order to ensure adequate protection of rights to both former victims and perpetrators.[44] Due to its resources, its experience in the field of international assistance, its high records of human rights and rule of law, and its

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[39] United Nations Support Mission in Libya, "UNSMIL Mandate," United Nations Website, http://unsmil.unmissions.org/Default.aspx?tabid=3544&language=en-US (accessed December 1, 2013).
[40] Ibid.
[41] Ibid.
[42] United Nations Support Mission in Libya, "Conference on Truth and Reconciliation in Libya Concludes with Recommendations on the Way Forward," United Nations Website, http://unsmil.unmissions.org/Default.aspx?ctl=Details&tabid=3543&mid=6187&ItemID=807743.
[43] "World Leaders Urge Libya Reconciliation," AlJazeera News Website, http://www.aljazeera.com/news/africa/2011/09/20119119919614337.html.
[44] Patryk Pawlak, "From protecting to rebuilding: The EU's role in Libya," in *Preventing Conflict, Managing Crisis. European and American Perspectives*, ed. Gross, Hamilton, Major and Rieke (Washington, DC: Center for Transatlantic Relations, 2011), 77.

political interest in securing peaceful post-war transition in Libya, the EU possesses a great potential to contribute to reconciliation process in the North African state.

The examples of the ICC, the United Nations, the NGO, and the EU demonstrate that foreign actors seek a role in post- conflict reconciliation practices, contrary to the assumption with regard to intrastate conflicts. It does not mean, however, that a general skepticism about their role in intrastate reconciliation is groundless. It comes from a legitimate concern regarding the political interests of the parties promoting reconciliation in Libya. The majority of actors contributing to reconciliation today have only recently become involved in the Libyan conflict. Political interests integral to their efforts in this sphere abandon roots of an original meaning of reconciliation, where the main feature of the practice is neutrality of a reconciling figure.[45] The etymological origin of the term demands today's political actors of reconciliation maintain neutrality in relation to parties they aim to reconcile. Political interests, however, maintain that preserving the neutrality of reconciliation in modern political setting is hardly possible. An overwhelming majority of foreign actors seeking to find a role in Libyan reconciliation favor certain scenarios of political development over others shaped by their own interests and concerns. This is not to say that foreign actors who demonstrate their will to promote reconciliation in Libya do not intend to do so. Their emphasis on the need for reconciliation seems to be grounded in their political interest in Libya and the wider region. However, it is precisely these political interests that undermine the theoretical neutrality that actors of reconciliation are supposed to observe. Foreign actors play a great role in shaping intrastate reconciliation practices but this role, however, is dubious as it blurs the original meaning of reconciliation, taking neutrality out of the picture. The question of foreign actors' involvement in reconciliation and a degree of their neutrality might shift a conventional theoretical conception of intrastate reconciliation practices.

Conclusion

Literature on reconciliation does not dedicate adequate attention to potential effects of foreign actors on reconciliation processes in sovereign states. This remains true although some of the related topics are covered more thoroughly. For example, the role of non-state actors in facilitating reconciliation has been addressed,[46] as has broader questions of international mediation in conflicts[47] and aspects related to conflict resolution and post conflict practice of reconciliation. However, a majority of these studies focuses on interstate conflicts with two or more sovereign states as participants. This approach is by no means useless or impractical; it is important to study practices of reconciliation between states to gain insight on how can one facilitate this process in the future. However, intrastate conflicts should attract the attention of politicians and scholars today.

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[45] Murray, Michael and Rea, Michael, "Philosophy and Christian Theology, "*The Stanford Encyclopedia of Philosophy* (Fall 2012 Edition), Edward N. Zalta (ed.), http://plato.stanford.edu/entries/christiantheology-philosophy/

[46] Shogo Suzuki, "Overcoming Past Wrongs Committed by States: Can Non-State Actors Facilitate Reconciliation," *Social and Legal Studies* 21(2), (2012): 201–13.

[47] Tobias Bohmelt, "Failing to Succeed? The Cumulative Impact of International Mediation Revisited," *Conflict Management and Peace Science* 30(3), (2013): 199–219.

This trend adds to the need to study reconciliation processes with respect to intrastate conflicts. This must include an assessment of potential actors of reconciliation, those who possess an ability to facilitate dialogue between reconciling parties, to overview a process of transitional justice in the state in question, and, generally, lead the process of reconciliation to its logical conclusion. Taking into account the growing internationalization of intrastate conflicts and the growing degree of involvement of foreign actors in their resolution, it is safe to assume that these actors would also be interested in contributing to post-war reconciliation processes. However, it is frequently said that any practice of reconciliation after an intrastate conflict must be initiated by its participants, both internally and in an independent manner. While this statement is not necessarily false, it must not reduce the importance of foreign actors' potential contributions toward successful practices of reconciliation in intrastate conflicts.

This paper has illustrated that there are a number of foreign actors, each of a different type, status, and ability, that can exercise a considerable impact on reconciliation development in a post-conflict society through the review of roles that foreign actors played in the reconciliation process in a post-Gaddafi Libya. The Libyan case demonstrates that foreign actors do seek an active role in promoting reconciliation in the aftermath of intrastate conflicts. Furthermore, the case demonstrates that initiatives aimed at promoting reconciliation can be initiated outside of the state in question and encourage and facilitate domestic-driven reconciliation efforts and programs. In addition, Libyan case has shown that a category of foreign players who have an ability to foster reconciliation after an intrastate conflict includes a number of actors, each of different nature. Hence, representatives of foreign states, intergovernmental organizations, international civil society, and of NGOs can all have their share in promoting reconciliation between hostile fractions within a sovereign state.

It is true that it remains difficult to assess the degree of success that their efforts have brought to reconciliation in Libya thus far. However, the intensity of their involvement and participation in nation-wide reconciliation efforts in Libya must not be underestimated; in addition to the effect their involvement has on a conventional and theoretical conception of reconciliation. This brief observation of roles and effects foreign actors have in Libya's reconciliation challenges a common perception of inability of foreign actors to play a substantial role in intrastate reconciliation practices. While efforts of some foreign actors might be limited, others may have a success in facilitating and organizational effects on promoting reconciliation in post-conflict states. The question, however, is whether their political interests shift a conventional conception of reconciliation that is characterized by neutrality of its brokers. To answer this, further research on the roles of foreign actors and their potential to contribute to reconciliation processes in post-conflict states is needed.

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Development of Infrastructure in the Kingdom of Cambodia: Export of Water Technology by Kitakyushu

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Abstract

Cambodia's infrastructure has been severely damaged by decades of conflict and civil war. Re-establishing systems of infrastructure has become the highest priority so as to develop the country and improve its people's quality of life. The city of Kitakyushu in Japan has been engaged in reconstructing Cambodia's water systems and developing its human resources since 1999, as part of its international cooperation work. As a result, the Phnom Penh Water Supply Authority has undergone remarkable recovery and growth, and most people in the city now have access to clean, safe water. This outstanding result is recognized as "The Miracle of Phnom Penh." This paper provides a summary of the efforts of Kitakyushu's development and water specialists in Cambodia.

Introduction

Infrastructure building is essential to social and economic development, including education, human rights, industry, and human life in general. Weak and failing infrastructure perpetuates poverty and is a serious obstacle to both welfare and to a country's development. Therefore, improving infrastructure is regarded as a top priority in breaking the cycle of poverty, and countries cannot be expected to develop without it.

The Kingdom of Cambodia is a Southeast Asian nation that, due to a long civil war that lasted until around 1990, is substantially less developed and poorer than its neighboring countries [1,2]. Owing to the chronic violent conflict, infrastructure such as water supply, electricity, and roads deteriorated to an extremely poor condition [3,4]. For example, in 1993, only 20% of Phnom Penh's residents had access to piped water. Lack of infrastructure was, and still is, one of the main factors stalling the country's development.

The city of Kitakyushu, located in the western part of Japan, is known as one of the biggest industrial areas in Japan. However, the city's remarkable industrial

development brought with it severe pollution. In the 1960s, several rivers and the Dokai Bay were highly contaminated by industrial and domestic wastewater [5]. In order to restore the health of the environment, Kitakyushu's city government implemented their own technologies, with support from local companies and universities, such as sewage maintenance management systems and industrial wastewater treatment technologies [6]. These efforts re-established Kitakyushu's safe natural environment.

Through this experiment of overcoming its own serious pollution, Kitakyushu's city government has long-standing ties with cities across Asia and has continued to provide support to water and environmental technologies. For example, in 2009, Vietnam introduced biological contact filter (BCF) purification, which is a technology patented by Kitakyushu, and Kitakyushu's city government also held a training program regarding capacity building of sewage facility managers in the city of Huhehaote, China [6].

As a result, Kitakyushu's technologies are highly acclaimed not only in Japan but also overseas. Furthermore, Kitakyushu was chosen by the Organization for Economic Cooperation and Development (OECD) as a "Green Growth Model City" of the world that is maintaining both economic growth and environmental sustainability [7]. Since the 1990s, Kitakyushu's city government has also pursued endeavors to export water infrastructure relating to international technical cooperation. Today, Kitakyushu's water technologies have already been used in many Asian countries, such as China, Vietnam, Saudi Arabia, and Cambodia. However, this road has not been an easy one.

In the course of preparing this paper, I investigated the current water infrastructure situation in Phnom Penh and explored how to create infrastructure in developing countries. In August 2013, I interviewed Kitakyushu's water experts, the director of the Department of Potable Water under the Ministry of Industry, Mining, and Energy (MIME) of the government of Cambodia, the Director General of the Phnom Penh Water Supply Authority (PPWSA), the First Secretary of Embassy of Japan in Cambodia, and a project formulation advisor of Japan International Cooperation Agency (JICA) in Phnom Penh. They described the wide variety of problems they had faced and the knowledge gained throughout the learning process. This paper summarizes the findings of my survey in Cambodia.

An important issue that became evident is that effective water supply requires excellence, specifically in the areas of human resources and management, as well as in technology and hardware. One reason for the success of the water supply in Phnom Penh was appropriate investment and cooperation in both of these areas.

Tracks of development of water infrastructure

Phnom Penh's infrastructure was severely damaged by more than 20 years of civil war that began in 1970. The water supply dissemination rate in Phnom Penh was 20%, and, before 1993, water was only available for 10 hours per day. Consequently, people were forced to perform the long, arduous work of collecting water. In order to solve this serious problem, in 1993, a new director was appointed to the PPWSA: Mr. Ek Sonn Chan. Chan initiated a thorough reform of the water agency, utilizing international development funding and expertise [8,9]. JICA accepted this request and offered funds to improve the water supply facilities. JICA provided a grant of $25 million in support of the PPWSA in 1995 and gave over $21 million in additional grant money in 1997. The PPWSA also received financial support from the World Bank and Asian Development Bank starting from 1997; however, these were not grants, but loans [10].

In 1999, Kitakyushu's city government also accepted Cambodia's request that they dispatch waterworks experts to Phnom Penh to develop water infrastructure and to train local staff. At that time, the non-revenue water rate, which is defined as the difference between the amount of water put into a distribution system and the water billed to consumers, was more than 70%. Such losses are mainly caused by leakage and water theft. Reducing the lost water was a serious problem for Cambodia, and the successful management of the PPWSA was considered a virtually impossible task.

The water and sewer bureau of Kitakyushu introduced the Zone-Monitoring System, which was developed uniquely by Kitakyushu, to address the water loss issues [11]. Since it is difficult to pinpoint the locations of leakage or water theft, the water supply network is split into a number of blocks with a water meter installed for each block. This system allows blocks in need of repair to be immediately identified. As a result, it can efficiently specify the precise locations of leaks or thefts, compared to the conventional method, and it successfully reduces the amounts of non-revenue water.

Figure 1 illustrates the reduction in the amount of non-revenue water in Phnom Penh from 1993 to 2010. This diagram shows a year-by-year decrease in the amount of non-revenue water; the amount of leakage was

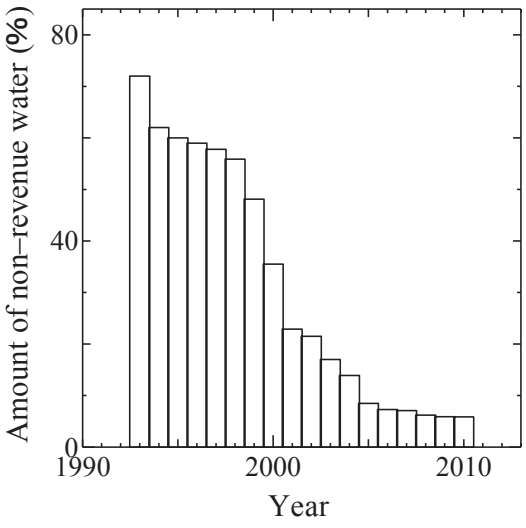

Fig. 1 Amount of non-revenue water in Phnom Penh

dramatically reduced from 72% to 6% or less, which is on par with developed countries.

Moreover, prior to Kitakyushu's provision of technical support, only 20% of people had access to piped water. Through the implementation of this cooperation, 90% of Phnom Penh's residents gained access to clean, safe water. Another outstanding result was that it became possible to drink water directly from the tap—a rarity in the world. In Asia in particular, such water is available only in Japan and Phnom Penh. These achievements have been lauded as a "miracle" and certainly provide an excellent model for other cities [12].

Phum Prek Water Treatment Plant

There are four water treatment plants in Phnom Penh. Among them, Phum Prek Water Treatment Plant, which is located next to the PPWSA, has the capacity to produce 150,000 m^3/day of potable water. The water supply is fed by the Mekong River, which flows from north to south through Phnom Penh to Vietnam.

Figure 2 depicts the facilities of Phum Prek Water Treatment Plant; the picture was taken during the author's research survey in Phnom Penh. This plant's water treatment mechanics are as follows:

1. Receiving and chemical dosing (Fig. 3)
The reception well intakes raw water and doses it with the chemicals calcium oxide (lime), polyaluminum chloride (PAC), and chlorine. This area also conducts the rapid mixing of chemicals in water.

2. Flocculation basin (Fig. 4)
Small flocs (flocculent masses) are joined together to make big flocs in order to facilitate quick setting.

3. Sedimentation basin (Fig. 5)
Big flocs are set at the bottom of the basin, and settled waters flow to the end of the basin.

4. Rapid sand filter (Fig. 6)
Small substances and flocs are filtered out, producing cleaner water.

5. Dosing chlorine (Fig. 7)
Chlorine is added to the filtered water to disinfect it.

This treatment method makes it possible to remove the brownish color from river water and eliminate harmful components such as arsenic and lead.

Figure 8 depicts the plant's control room, which monitors and controls the plant 24 hours a day. Initially, Japanese experts from Kitakyushu created the plant's standard operating procedures and instructed the management on how to run the plant. However, the staff of the PPWSA are highly skilled, and they manage the plant independently now. Moreover, the PPWSA staff are transferring their skills to other water engineers at various provinces in Cambodia.

Fig. 2 Phum Prek Water Treatment Plant

Fig. 3 Reception well

Fig. 4 Flocculation basin

Fig. 5 Sedimentation basin

Fig. 6 Filter basin

Fig. 7 Chlorine dosing basin

Fig. 8 Control room

Key to success in infrastructure building

Cambodia's schooling and education system was destroyed during the Pol Pot regime. A large number of people were executed as a consequence of his policies: it is estimated that, out of a population of approximately eight million, about two to three million people perished, and doctors, teachers, and literate people were disproportionately targeted. For this reason, most Cambodian people have had little education.

In order to assist these people with their work, Kitakyushu's experts put particular effort into human resource development at the PPWSA. They instructed local staff not only in the knowledge and technology of water infrastructure but also in Arabic numbers and methods of calculation. The water and sewer bureau of Kitakyushu also provided the PPWSA staff with work uniforms in order to increase their motivation to work and raise their morale. The system of allocating personnel also had a positive effect on the water business management. For example, the PPWSA made efforts to assign jobs according to each staff member's capabilities. Addressing these human resources issues was key to the successful development of water infrastructure in Phnom Penh.

Following these successful programs, many Cambodian agencies have developed a deep level of trust in the experts from Kitakyushu. Kitakyushu's city government now has agreements to provide technical cooperation to 10 Cambodian cities: Siem Reap, Battambang, Kampong Thom, Mondulkiri, Pursat, Kampong Cham, Preah Sihanouk, Kampot, Krong Kep, and Svay Rieng. Many residents of these cities still have no access to clean drinking water, and there is an increasing demand for water driven by population growth. The annual population growth rate in Cambodia is 1.8%, which is about nine times higher than that of Japan [13], and it is estimated that the population of urban areas will double from 2010 to 2030 [14]. Accordingly, Kitakyushu is increasing its efforts to tackle the problem of access to clean water and aims to develop water infrastructure throughout the country.

Conclusion

Since 1999, the water and sewer bureau of Kitakyushu has cooperated with the PPWSA to construct water infrastructure and has provided Cambodia with knowledge and technology to this end. As a result, about 90% of households in Phnom Penh now have access to potable water, and 24-hour stable water services have been made available.

It is clear that the presence of well-qualified people is crucial for any developing country where the construction of infrastructure is an important priority, and development needs to be made with a long-term perspective. In other words, human resource development is vital to developing countries, and the key is to train and secure human resources who can support ongoing development and pass their skills on to others.

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