# Japan-Brazil Joint Workshop "Towards Sustainable Urban Energy Systems: Experiences from Asia and Latin America"

## 1-3 February 2018

**Venue:**

Institute of Advanced Energy, Kyoto University, Japan

**ORGANIZED BY:**

FGV EAESP

Institute of Advanced Energy KYOTO UNIVERSITY

**FUNDING ORGANIZATIONS:**

FAPESP

Japan Society for the Promotion of Science 日本学術振興会

## INTRODUCTION AND PURPOSE OF THE WORKSHOP:

Climate change has exacerbated the existing urban environmental management challenges in cities. At the same time, cities are responsible for a significant part of the global greenhouse gas emissions, and given current demographic trends, this level will likely only increase over time. These challenges highlight the need for cities to rethink how assets are deployed and people protected, how infrastructure investments are prioritized, and how climate will affect long-term growth and development plans.

The overall aim of this workshop is to a solid understanding of key policies and instruments which can be developed in order to boost the capacity of societies to establish a low carbon energy system in Asian and Latin American cities and achieve the local and global goals of sustainable development. The main aim of the proposed workshop is to discuss policy-oriented research on clean energy solutions in Asian and Latin American cities. The Sustainable Urban Energy System, which is proposed in this workshop refers to the development and implementation of policies and strategies that simultaneously contribute to addressing climate change and solving local environmental problems, which also have other development impacts. This workshop provides insights to a wide audience on successful ways to promote, design and implement the low carbon urban energy system in Asian and Latin American cities.

The objective of this workshop is to bring together young researchers and practitioners from Japan and Brazil to discuss how we can develop policies and instruments to boost the capacity of societies to establish a low carbon energy system in Asian and Latin American cities and achieve the local and global goals of sustainable development with a special focus on:

- How clean energy planning contributes to urban resilience and sustainability?
- Which initiatives are most promising? What are their policy implications?
- What is the rule of local governments in deploying sustainable urban energy system?
- What are the main drivers and challenges for the sustainable urban energy system?

## APPLICANTS: YOUNG SCHOLARS

This workshop invites young scholars from Japanese or Brazilian universities with an interest in sustainable urban energy or similar fields. Young scholars here are interpreted as Ph.D holders that have received their diploma in less than 10 years ago. Young scholars are asked to submit their extend abstract (500-1000 words) which should be included theories/perspectives, research methods, results and findings. The articles should be based on empirical research and policy-oriented.

***This comprehensive three-day workshop is financially supported by the Japan Society for the Promotion of Science (JSPS) and the Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP).***

## ORGANIZING COMMITTEE

- Hooman Farzaneh, Institute of Advanced Energy, Kyoto University
- Jose A. Puppim de Oliveira, Getulio Vargas Foundation (FGV), Management School of São Paulo (FGV/EAESP)

## SCIENTIFIC COMMITTEE

- Hideaki Ohgaki, Institute of Advanced Energy, Kyoto University, Japan
- Aki Suwa, Kyoto Women's University, Japan
- André Pereira de Carvalho, FGV/EAESP, Brazil
- Charbel Jabbour, UNESP - Sao Paulo State University, Brazil
- Hooman Farzaneh, Institute of Advanced Energy, Kyoto University, Japan
- Jose A. Puppim de Oliveira, FGV/EAESP, Brazil
- José Carlos Barbieri, FGV/EAESP, Brazil
- Keiichi N. Ishihara, Kyoto university, Japan
- Antonio José Junqueira Botelho, Kyoto university, Japan

## EXECUTIVE COMITTE:

- Ms. Yumiko Nagaya, Institute of Advanced Energy, Kyoto University, Japan
- Ms. Sasha Yoshioka, URA Office, Kyoto University, Japan
- Ms. Keiko Takimoto, URA Office, Kyoto University, Japan

## Website:

http://www.ceac.iae.kyoto-u.ac.jp/JointWorkshop.html


## VENUE

Institute of Advanced Energy, Uji campus, Kyoto University, Gokasho, Uji, Kyoto.

# W-503E is located on 5th floor in Main building, Uji campus.

## Access

Uji campus

Kyoto === JR Obaku

JR West Nara Line (Kyoto #8,9,10 platform)

Local (Rapid Train skips Obaku Station)

The required time about 23min. (every 15 minutes)

## Workshop Program

| **DAY 1** | | |
|---|---|---|
| 10:00 – 10:30 | Welcome Address and program overview | Hooman Farzaneh, Kyoto University, Japan<br><br>Jose A. Puppim de Oliveira, FGV/EAESP |
| **Session I:**<br>Chairs: Aki Suwa and Jose C. Barbieri | | |
| 10:30 – 11:30 | Urban energy and climate change | Jose A. Puppim de Oliveira, FGV/EAESP |
| 11:30 – 12:00 | Low carbon urban energy system scenarios in Asian Mega cities | Hooman Farzaneh, Kyoto University, Japan |
| 12:00 – 12:30 | The Role of Japanese Cities in Ensuring a Carbon Free Electricity Grid | Miguel Esteban, The University of Tokyo, Japan |
| 12:30 – 12:45 | **Group photo** | |
| 12:45 – 14:00 | **Lunch** | |
| **Session II:**<br>Break up session with young scholars's presentations | | |
| 14:00- 15:30 | **Session II-A: Renewable Energy**<br><br>**Chairs: Aki Suwa/Andre Carvalho**<br><br>**Cooperation and forecasting of solar energy technologies applied to Japan and Brazil.** Alex Fabianne de Paulo, University of São Paulo – USP<br><br>**Renewable energy deployment in Uzbekistan: wind/solar power development.** Nigora Djalilova, The University of Tokyo<br><br>**Bioenergy Potential from Agricultural Residues in the State of São Paulo, Brazil (Preliminary Analysis).** Bruno Barbosa, University of São Paulo –USP | **Session II-B: Technologies**<br><br>**Chairs: José C. Barbieri/Antonio J.J. Botelho**<br><br>**Options and limitations for road transportation in urban areas and megacities in a carbon constrained scenario.** Larissa de Souza Noel Simas Barbosa, University of São Paulo–USP<br><br>**Thailand's renewable energy transition from utility-scale project to residential technological adoption.** Ranaporn Tantiwechwuttikul, The University of Tokyo<br><br>**Measuring Externalities in an Information Commons: The Case of Libraries.** Matheus Albergaria de Magalhães, Fundação Escola de Comércio Álvares Penteado (FECAP) |
| 15:30 – 16:00 | **Tea Break** | |
| 16:00-17:00 | Preparation of the scenarios exercise on Day 2, Hooman Farzaneh and Jose A. Puppim de Oliveira | |
| 17:00-17:30 | Wrap-up | Jose A. Puppim de Oliveira |
| 17:30-19:00 | **Reception** | |

| **Day 2** | | |
|---|---|---|
| **<u>Session III:</u>**<br>Break up session with young scholars's presentations | | |
| 11:00- 12:30 | **<u>Session III-C: Assessment and Evaluations</u>**<br><br>**Chairs: Keiichi N. Ishihara/José C. Barbieri**<br><br>**Evaluation of long-term urban transition in a megacity based on alternative socioeconomic pathways.** Miho Kamei, Institute for Global Environmental Strategies (IGES)<br><br>**Evaluation of Relationship between Embodied Energy and Transport Energy of Cities in Japan.** Junichiro Oda, Research Institute of Innovative Technology for the Earth (RITE)<br><br>**A life cycle assessment of greenhouse tomato production in an agrivoltaic system.** Leon Ai, Kyoto University | **<u>Session III-D: Planning, Governance and Capacity Building</u>**<br><br>**Chairs: Chairs: Antonio J.J. Botelho/Andre Carvalho**<br><br>**A case study of climate change adaptation governance in Peshawar Valley of *Khyber Pakhtunkhwa*, Pakistan.** Muhammad Mumtaz, Fundação Getulio Vargas (FGV)<br><br>**Women have energy to boost: A Capacity Building Approach for Sustainable Energy Consumption**. Isabel B. Franco, The United Nations University, Institute for the Advanced Study of Sustainability (UNU-IAS)<br><br>**Energy Visions of Japan's Postwar Planning Theory.** Andrea Flores Urushima, Kyoto University |
| 12:30: 14:00 | **Lunch** | |
| **<u>Session IV:</u>**<br>Chair: Hooman Farzaneh | | |
| 14:00- 16:00 | Practicing with the Urban Energy Scenario Analysis tool | |
| 16:00: 16:30 | **Tea Break** | |
| **<u>Session IV:</u>**<br>Chairs: Hideaki Ohgaki and Jose A. Puppim de Oliveira | | |
| 16:30-18:30 | Lessons learned from the sustainable urban energy development in Asia and Latin America, closing | |

| **Day 3** | **Jointly with the 3rd international workshop on clean energy development in Asian Cities: Experiences from Asia and Latin America** | |
|---|---|---|
| 10:30-12:15 | Presentations by the Asian and Latin American invited speakers | |
| 12:15-13:45 | **Lunch** | |
| 13:45 -17:15 | Presentations by the Asian and Latin American invited speakers | |
| 17:15-18:00 | FAPESP-JSPSP young scholars' presentations of their achievement in assessing sustainable urban energy systems in Asian and Latin American cities + Q&A session | |
| 18:00 – 18:20 | Closing Remarks | Keiichi N. Ishihara, Kyoto university, Japan |
| 18:30-20:30 | **Dinner** | |

## A BRIEF REPORT ON WORKSHOP

The Japan-Brazil joint workshop on "Towards Sustainable Urban Energy Systems: Experiences from Asia and Latin America" was held on 1-3 February 2018 at the Institute of Advanced Energy, Kyoto University. This comprehensive three-day workshop was built around a number of lectures from the Japanese and Brazilian experts in order to further explore best practices for sustainable urban energy system development, following the four main sessions:

**Day I**

***Introductory Session:***

Introductory remarks were made by the co-organizers and members of the scientific committee. Professor Hideaki Ohgaki, Kyoto University, gave a welcome message. Professor Jose A. Puppim de Oliveira, FGV/EAESP, and junior associate professor Hooman Farzaneh, Kyoto University, introduced the workshop objectives and schedule


Hideaki Ohgaki

Hooman Farzaneh

Jose A. Puppim de Oliveira

***Plenary Session:***

Three members of the scientific committee of the workshop presented their experiences about clean energy development and its applications in Asian cities. Professor Jose A. Puppim de Oliveira, spoke about the transformation of clean energy for Sustainable Development in Urban Asia. He in his presentation, highlighted that, these transformations in Asian cities will occur only if policymaking frameworks for energy systems are able to recognize the ecological limits at the different scales, from local to planetary, as we have seen in the recent Paris climate agreement. Dr. Hooman Farzaneh, introduced the ongoing research project at the institute of advanced energy, entitled "Clean energy development in Asian mega-cities" which aims to develop a new strategic planning mechanism for achieving multiple benefits of clean energy development in Asian mega cities, together with a robust analytical framework that can be used to assess those benefits during the development and implementation process. The third speakers of this session, Associate Professor Miguel Esteban, The University of Tokyo, described his new model that simulates the electricity grid in Japan, ensuring 100% reliability while only using renewable energy sources and electrical batteries. He presented about the model results which reveal how this would represent a significant proportion of the Japanese land, and would mostly require them to be used on top of houses.



Jose A. Puppim de Oliveira, Hooman Farzaneh and Miguel Esteban giving their presentations

***Break up session with young scholars' presentations (part one):***

In two parallel sessions, the young scholars from Brazil and Japan addressed in detail the role of executive clean energy policy targets to support the climate change mitigation in the selected Asian and Latin American cities. Alex Fabianne de Paulo, University of São Paulo – USP, started his presentation with a focus on cooperation and forecasting of solar energy patents applied between 1997 and 2016 in the main patent offices around the world. He explained his methodology which was based on Social Network Analysis (SNA) technique and highlighted how using this methodology can provide a better understanding of solar energy innovations applied to Asian-LATAM countries. Nigora Djalilova, The University of Tokyo, presented the policy related aspects and legislative framework development in the renewable energy sector in Uzbekistan and explained about the changes to government policy that are recently taking place in the country, and question the consistency of such changes with the course taken towards increasing the share of renewables in power generation. Bruno Barbosa, University of São Paulo –USP, proposed a way to carry out a Water-Food-Energy-Land Nexus assessment approach in order to understand the existing interactions between water, energy, land and food systems concerning the use of biomass for bioenergy on the

context of the São Paulo State of Brazil. Larissa de Souza Noel Simas Barbosa, University of São Paulo–USP, presented the urgency for addressing climate change as well as the need for increasing the efficient use of natural resources such as biomass as the main foundations for the construction of an environmentally, economically and socially sustainable society in the Brazilian cities. The next speaker, Ranaporn Tantiwechwuttikul, The University of Tokyo, shared Thailand's renewable energy transition future plan and remarked that the Thai government encouraged RE technological adoption and provided generous incentive through the Adder program since 2007 - which applied for six RE technologies i.e. biogas, biomass, hydro, municipal solar waste (MSW), solar photovoltaics (PV), and wind energy. The final speaker of this session, Matheus Albergaria de Magalhães, Fundação Escola de Comércio Álvares Penteado (FECAP), gave his talk on employing a novel dataset related to more than 700,000 transactions in distinct libraries during a 10-year period (2006-2015) and his estimation on the external effects of the actions of library users who were subject to a monetary sanction and its effect on sustainable cities development in Latin America.

Break up session with young scholars' presentations (part one)

First day reception with the young scholars from Brazil and Japan

**Day II**

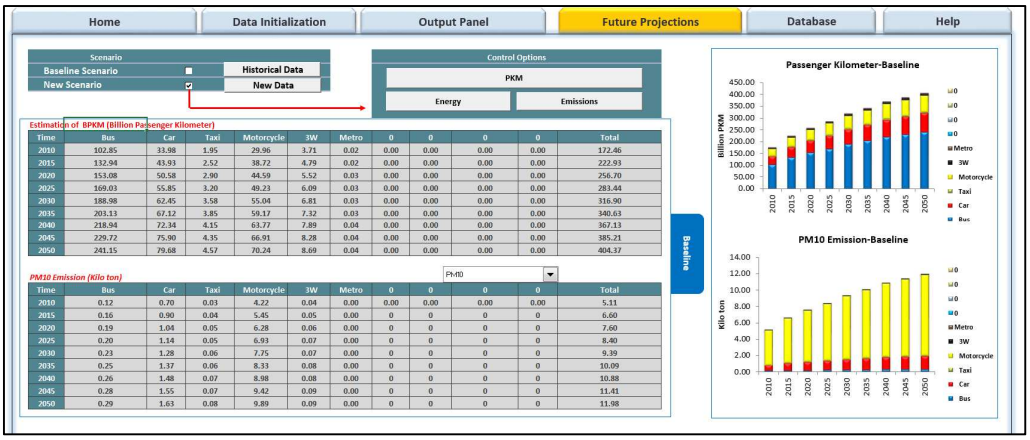
***Break up session with young scholars' presentations (part two):***

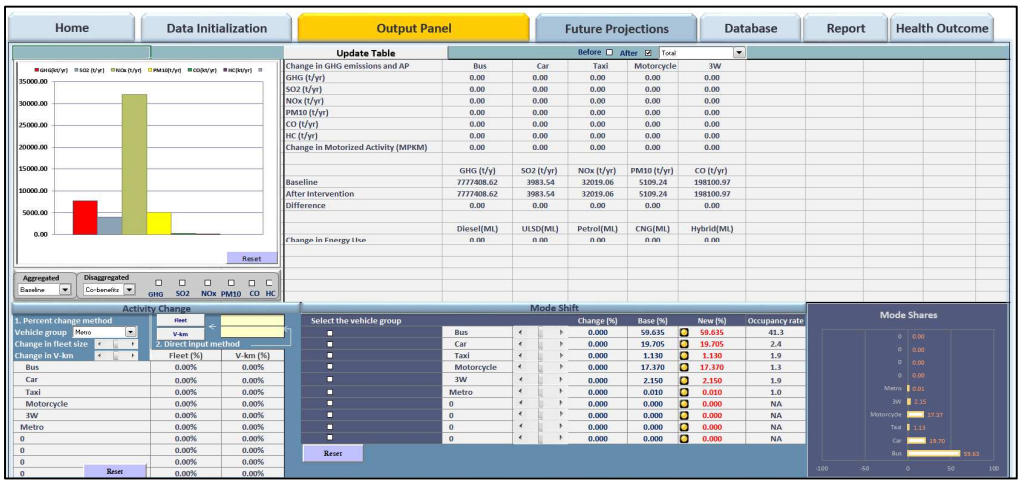
Second part of the break up session with young scholars was centered on two main areas of 1) Assessment and Evaluations and 2) Planning, Governance and Capacity Building. In this session, the first speaker, Miho Kamei, Institute for Global Environmental Strategies (IGES), talked about the socioeconomic pathways for the urban scale in Tokyo. She highlighted the significant explanatory variables which may influence the building scrap rate and the impact of those variables on carbon emissions in Tokyo. Junichiro Oda, Research Institute of Innovative Technology for the Earth (RITE), gave his talk on the evaluation of relationship between embodied energy and transport energy of cities in Japan. His research indicated that the large cities with abundant public transport have the relationship to small transport energy use and large embodied energy use and density, access to public transport, and degree of abundance of flat area have also relationship to transport energy and embodied energy even in similar population cities. The third speaker, Leon A, Kyoto University, presented the impacts of the Functional Unit (FU) on life cycle CO2 emissions in agrivoltaic systems. She explained about the implementation of the FU method in a real case study in an experimental greenhouse in Kizugawa, Kyoto. The next speaker, Muhammad Mumtaz, Fundação Getulio Vargas (FGV), discussed about how Pakistan is blessed with renewable energy resources such as wind, solar, hydro, and biomass and how these renewable resources can play an instrumental role to curb energy crises and to ensure the sustainable energy development of the country. Isabel B. Franco, UNU-IAS, opened a new chapter on how existing capacity-building approaches can be used in order to assist women in protecting their assets and capacities and reverse the effects of unsustainable energy consumption. She highlighted what the main capacity-building priority areas are and how valuable they are for women. The final speaker of this session, Andrea Flores Urushima, Kyoto University, gave a talk on energy visions of Japan's postwar planning theory and concluded that In order to cope with environmental degradation, to decentralize urbanization and to stimulate people's permanence in small and medium sized cities, the re-evaluation of everyday lifestyles in rural and town areas would be needed

Break up session with young scholars' presentations (part two)

***Training Session:***

A hand-on exercise session was conducted in order to provide training for the Urban "Co benefits Evaluation Tool" that the coordinators of this workshop have jointly created to quantify the implications of low carbon scenarios in the urban transport sector. The Evaluation Tool combines a quantitative spreadsheet of a simplified representation of the transport sector with an institutional evaluation to evaluate not just the magnitude of emission reductions from local air pollution and carbon emissions but also to determine barriers to implementation of policies and projects. This assessment tool uses the framework to consider what co-benefits would accrue if local air quality and carbon emissions were the main criteria used in the decision-making process. In this session, first, Dr. Hooman Farzaneh gave a simple demonstration of the tool and participants were introduced to how to use the tool (input data and interpret the results). Then, the installation of the tool on the computers of each participant, allowed them to directly apply the tool and become familiar with its use and the various aspects to consider for implementation. The city of Delhi, India was considered as a case study in the tool and the participants tried to design a potential 2050 scenario for this city. Using the tool, participants were able to quantify the implication of low carbon and clean energy scenario and to estimate the multiple benefits (Energy, Environment, public health and economic development) of their proposed scenarios in the transport sector of this city.




Snapshots of the Co benefits Evaluation Tool

Participants practice with the tool

***Lessons learned Session:***

In this session, Professor Jose A. Puppim de Oliveira discussed about the lessons learned from the sustainable urban energy development in Asia and Latin America. First, He classified the similarities and difference between urban energy systems in Asia and Latin America as follows:

**Similarities:**

- Problems: pollution, need to improve services
- Urbanization patterns (modernism and car)
- Solutions

**Differences**

- Urbanization pace
- Energy resources and carbon intensity
- Infrastructure
- Institutional (Asia more centralized)
- Implementation flexibility
- Trust in institutions

Then, both Brazilian and Japanese young scholars shared the outcomes and the used methodologies in their studies each other, including clean technology and new assessing methodology used in both countries. The participants discussed about the several factors beyond economics and finance (e.g., trust, local initiative, culture, spatial dimensions) which can influence the suitability of the urban energy system in both Asia and Latin America. They also discussed about the new chances for future collaboration in sustainable urban energy development in which the participants from both countries can work together.

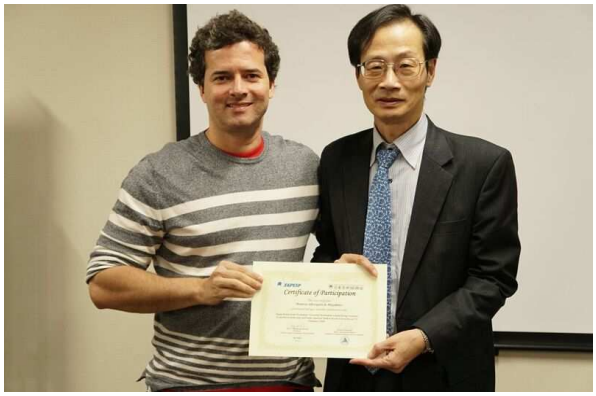
Group photo of the FAPESP-JSPS joint workshop

**Day III**

On the third day of the workshop, the participants attended the 3rd international expert workshop on clean energy development in Asian and Latin American cities which was held on Feb 3, 2018 at the Institute of Advanced energy, Kyoto University. The workshop was attended by over 9 keynote speakers from India, Japan, Malaysia and Australia. These included:

| Speaker | Keynote Topic |
|---|---|
| Dr. Wang Xin, UNEP-Tongji Institute of Environment for Sustainable Development (IESD), Shanghai, China | A Post Evaluation of Solar City Demonstration Project in Turpan, China |
| Prof. Nasrudin Abd Rahim, University of Malaya, Malaysia<br>Dr. H.S. Che, University of Malaya, Malaysia | Towards a Cleaner Nation - Renewable Energy Motivations in Malaysia |
| Mr. Inchul Hwang, International Cooperation Team, Global Strategy Division, Korea Energy Agency (KEA), South Korea | Compact Energy Consumption: Urban Way of Energy Saving |
| Dr. Eric Zusman, Institute for Global Environmental Strategies (IGES), Japan | Co-benefits: A Comparative Analysis of Enablers and Barriers |
| Prof. Antonio Botelho, Visiting Professor, Kyoto University, Japan & Universidade Candido Mendes, Brazil | Pragmatic Collaboration for Resilient Climate Co-benefits Policy Implementation |
| Dr. Scott Kelly, University of Technology Sydney, Australia | A tale of five cities: How Tokyo, Sydney, Shanghai, Kuala Lumpur and Delhi are creating strategies for low emissions development |
| Dr. Yuki Kudoh, AIST, Japan | The way forward for a clean and sustainable transport in Asian cities |
| Dr. Mahendra Sethi, ISARD, New Delhi, India | Targets and Supporting Strategies for the Clean Energy Development in Delhi |

In the afternoon session, Professor Jose A. Puppim de Oliveira and Dr. Hooman Farzaneh presented the main achievements of the FAPESP-JSPS joint workshop and shared a brief summary on the young scholar' presentations carried out during first and second days of the workshop. There was a Q&A session after their presentations with the expert invitees and speakers at this workshop.
In the closing session, the certificate of participation was awarded to the young scholars by Professor Keiichi N. Ishihara, dean of the graduate school of energy science Kyoto University.


Certificate of participation awarded to the young scholars

Group photo of the joint workshop of the 3rd international workshop on clean energy development in Asian Cities: Experiences from Asia and Latin America and FAPESP-JSPSP

Workshop Dinner

**Energy Visions of Japan's Postwar Planning Theory**

Andrea Flores Urushima, Kyoto University, (KU-CSEAS), Japan

The 1960s' period witnessed the most important internal migration of Japan's population since the modern period with the definitive shift from a rural into an urban-based society. According to (Flores Urushima 2012, 131) until 1950, rural based activities sustained the economy of the country. From 1960 on the numbers of the economically active population in urban related activities suddenly doubled. The majority of economically active population began to be employed in cities with a permanent decrease in importance of rural based activities. Moreover, there occurred an increase in the urban population from 11% in 1898 to 78% in 2000, with the most relevant and sudden change having place in 1960.

This abrupt shift towards an urban-based society reflects the increasing importance of cities all over the world and especially in Asia (Flores Urushima 2011a). The 1960s-1970s period was a crucial period for the establishment of Japan's urban national structure and witnessed the increased use of strategic mechanisms of urban development. It was the period when developer's role gained in importance and megaevents were enthusiastically promoted (Flores Urushima 2011, 2009, 2008 and 2007). Planning theory and planners of that period had to respond to a rapid urbanization concentrated in the Pacific Belt metropolitan area, and their planning concepts greatly structured the form of nowadays' Japanese cities. In opposition to the shrinking of towns and villages in isolated rural areas, metropolitan areas were affected by suburban sprawl, congestion in central districts, and environmental degradation, among others.

The unprecedented transformations led the Japanese Central Government to request visions for the prospective development of the national territory in an open competition. Responding to this open call, extent reports were produced and debated between 1967-72, mobilizing a wide network of influential representatives in urban making such as sociologists, economists, urban planners and architects. This is illustrated by the participation of the Foreign Minister Okita Saburo, who later became the head of the Japanese government advisory group that suggested the creation of the UN World Commission on Environment and Development, i.e. the Brundtland Commission in 1987.

In order to cope with environmental degradation, to decentralize urbanization and to stimulate people's permanence in small and medium sized cities, most reports advocated the re-evaluation of everyday lifestyles in rural and town areas. Moreover, to limit rural exodus many reports suggested the need to generally spreading the main advantages and comfort of a metropolitan lifestyle to all regions. To support a sustainable development flexible to economic and social change the reports emphasized the value of natural landscapes and traditional lifestyle for their esthetical and environmental qualities. The reports proclaimed the rise of an information society and stressed the growing importance of leisure and tourism activities, nowadays one of the most profitable industries worldwide (Urushima 2015).

This presentation will analyse the reports' contents by looking at how planners viewed the relationship between energy and the balanced maintenance of cities, towns and villages in the midst of severe environmental crisis. The most important conceptual change in the planning theory of the period was that planners began to question the traditional focus on physical planning and control viewpoint. Although until recently, Japanese statutory planning has excluded mention to rural development, it is possible to see in the visionary proposals of the above cited reports a subtle emergence of a systemic notion of cities' functioning. This systemic notion acknowledges the importance of keeping a balance between human energy (as source for labour and as knowledge powerhouse) with non-human energy needed to main the pace of industrial growth (from petroleum to nuclear sources). This systemic notion has largely developed from an accumulated experience of National Planning *Kokudo Keikaku* under war mobilization, which allowed the building of an indispensable institutional framework readily mobilized during the reconstruction period, which led to the subsequent development of Postwar regional planning. Until the end of the war, energy was a relevant concern for national planning interests of fuelling industrial development and was centrally organized by the MITI. However, during the 1960s period the discussion about energy gains nuanced complexity towards receiving attention as a central matter for everyday life at the regional scale. (684 words)

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# Evaluation of Relationship between Embodied Energy and Transport Energy of Cities in Japan

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The energy consumption for transportation is strongly related to the urban population density. Energy consumption for transportation is large in cities with low density such as Atlanta, and that is small in cities with high density such as Barcelona (Lefèvre, 2010). Conversely, previous literature suggests that embodied energy consumption derived from the demands for steel and cement is large in high density cities through the development of concrete buildings and public transportation. Climate policy and urban planning should address the trade-off between transport energy and embodied energy derived from the demands for steel and cement (Doherty et al., 2009; Resch et al., 2016).

This paper quantitatively investigates the relationship between embodied energy and density as well as the relationship between transport energy use and density. The analysis target is embodied energy of residential building and transportation energy. The geographical coverage and classification of this analysis are midsize and large cities and prefectures in Japan.

## Methods

The stock of steel and cement is estimated based on the historical steel and cement shipping amount by prefecture. We distribute them into city and rural total based on population, typical intensity and literature data. The obtained stock of steel and cement is converted into embodied energy per capita per year. Transport energy consumption by city is estimated based on prefecture data and literature data.

We conduct a multiple regression analysis, and response variable is the obtained energy consumption (embodied energy and transport energy). Explanatory variables include the average per capita income, population density, population size, land space per house, flat land/slope index, and public transport index. The flat land/slope index represents the degree of abundance of flat area. Flat-area-abundant cities such as Nagoya and Niigata would tend to be low density, less public transport and high transport energy city. On the other hand, flat-area-scarce cities such as Kyoto and Kobe would tend to be high density, abundant public transport and low transport energy city. In order to avoid multi-collinearity, we select some effective explanatory variables.

## Expected Results

The expected results include that large cities with abundant public transport have the relationship to small transport energy use and large embodied energy use. In other words, large embodied energy consumption partly offsets the effect of small transport energy use. Density, access to public transport, and degree of abundance of flat area have also relationship to transport energy and embodied energy even in similar population cities. Since the density, access to public transport, and degree of abundance of flat area correlate to each other, and the degree of abundance of flat area is the given condition, policy options and urban planning for fostering $CO_2$ emissions reduction would be more challenging than we thought.

**References**

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**The Role of Japanese Cities in Ensuring a Carbon Free Electricity Grid**

Miguel Esteban[1], Benjamin McLellan, Joana Portugal-Pereira, Hooman Farzaneh, Jeremy Bricker, Keiichi Ishihara, Volker Roeber, Hiroshi Takagi

In the aftermath of the United Nations Climate Change Conference in Paris in 2015 many countries have pledged to decrease their greenhouse gas emissions. To do so, it is imperative that many of them increase the amount of renewable energies within their electric grids. However, renewable energy systems depend on variable environmental conditions (sunshine, wind, water reserves, or the waves and currents), and are often criticised as not being reliable. Essentially, to compensate for the intermittency and smoothen the electricity supply profile there is the need to integrate a wide range of types of renewable energy that are geographically distributed throughout an area that is as large as possible. The use of a variety of electrical storage mechanisms can also play a role in balancing such a system.

Although a number of studies have indicated that such systems are feasible, important questions remain regarding the amount of land surface that would be needed to implement such systems. Thus, in the present work the authors developed a model that simulates the electricity grid in Japan, ensuring 100% reliability while only using renewable energy sources and electrical batteries. The simulation uses hourly meteorological data to simulate the amount of electricity that could be produced, and this was compared with the hourly electricity demands imposed on the system. Once the amount of solar PV required for such a system to work was computed, the authors calculated the land surface that would be required. The results highlight how this would represent a significant proportion of the Japanese land, and would mostly require them to be used on top of houses.

In essence, although the population of cities is responsible for much of the demand for electricity that drives climate change (through increases in greenhouse gas emissions), solar photovoltaic technology also provides them the opportunity to be part of the solution. To do so, it is necessary that the Japanese government further incentivises private individuals to not only install PV panels on their rooftops, but to also start acquiring the batteries or electric cars that will be necessary to smoothen the contribution of such systems. The establishment of smart grids and distributed electricity systems will thus be essential for cities to start to move away from being mere consumers of electricity and become more self-sufficient.

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**Impacts of functional unit on life cycle $CO_2$ emissions in agrivoltaic systems**

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The choice of a functional unit (FU) influences on the results of LCA. The aim of this study is to evaluate the possible impacts of FU on the LCA results in agrivoltaic systems. In an agrivoltaic system, photovoltaic (PV) modules are ground mounted between crops, replace a part of the greenhouse or set below or above the cover film of the greenhouse. The system could provide solutions for climate change mitigation. However, such expectation is limited by the fact that power generation by PV reduces sunlight and so yield of crops might be reduced. To maintain the main function of agricultural land as crop production, it is required to consider how to conduct LCA. The present study investigated the choice of FU. Two FU, mass-based and area-based were used to compare LCA results of agrivoltaic and conventional tomato systems as a case study.
The application rate of fertilizer differed slightly between agrivoltaic and conventional systems. The yield of tomatoes was reduced by 10 % in the agrivoltaic system (1513 kg in the agrivoltaic system and 1669 kg in the conventional system). Heating electricity consumption was lower by 30 kWh in the agrivoltaic system than that in the conventional system. The LC-$CO_2$ emissions in the agrivoltaic system and in the conventional system were 2.8 and 2.9 kg-eq $CO_2$ per kg tomatoes, respectively when mass-based functional unit is used, whereas they were 4249 and 4911 kg-eq $CO_2$ per area when area-based FU is used.

Because of the power generation and reduction in heating load demand, LC-$CO_2$ emissions were lower in the agrivoltaic system compared to the conventional system irrespective of the choice of FU. However, the reduction rate of LC-$CO_2$ emission (i.e. the difference in LC-$CO_2$ emissions between agrivoltaic and conventional systems divided by the LC-$CO_2$ emission of the conventional system) varied depending on FU. That is, the LC-$CO_2$ emission was only 5 % lower in comparison with the conventional system when the mass-based FU is used, whereas it was 13 % lower when the area-based FU is used. Results suggest that the area-based FU uses land more efficiently than the mass-based FU to reduce LC-$CO_2$ emissions. However, using only an area-based FU ignores the negative impact of PVs on yield, which is addressed by a mass-based FU. Based on these results, policy implications for introducing agrivoltaic systems are discussed.

Because of shadow casted by PV, previous studies have noted a reduction in the yield. The system therefore would lead to competition for solar radiation (i.e. the more power is generated by increasing PV sheets, which increases shadow, the less crop may be produced, and vice versa), which in turn will indirectly cause a change in the land use. That is, to compensate for the yield reduction, demand for land will increase, and so uncultivated land will start to be used to cultivate crops. This indirect land use change may increase carbon emissions, especially if forest and pasture is changed into crop land. An appropriate regulation will be required to avoid this.
A critical point in the regulation would be whether to restrict crops in the agrivoltaic systems to be shadow tolerant crops. One factor to take into consideration is that in heating greenhouses, heating accounts for a large share of the LC-$CO_2$ emissions. Therefore, allowing also for crops that do not tolerate the shadow in heating greenhouses would reduce the emissions.

A technological development in PV, especially the semi-transparent PV, allows cultivation of a wide range of crops. The semi-transparent PV transmits visible light used for photosynthesis, while it absorbs near infrared radiation range for power generation. Wavelength-selective photovoltaic systems (WSPS) where silicon-based PV is combined with luminescent solar cell technology, transmits the wavelength range for photosynthesis, but absorbs wavelength ranges of blue and green. The authors observed minimum influence of WSPV on weights and number of tomatoes.

Accordingly, a wide range of crops could be grown in agrivoltaic systems provided that there is a regulation that limits the maximum yield reduction or the covering ratio by PV, as is currently the case in the Japanese and Italian regulations, respectively. In the Japanese regulation, an agrivoltaic system is not allowed if the yield is reduced by more than 20 %, the quality of crops is seriously deteriorated, or if the efficient operation of the agricultural equipment is hampered. In Italy, local laws allow the covering ratio to be between 25 and 50 %.

**WOMEN HAVE ENERGY TO BOOST: A Capacity Building Approach for Sustainable Energy Consumption**

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There is an increasing interest in the literature in exploring how women can boost their assets and capacities to cope with the effects of unstainable energy consumption, such as use of pollutants and waste, use of fossil fuels, inadequate compensation for the loss of livelihood options and lack of corporate accountability. In the practicality, global and local stakeholders have built women's capacity and set technical assistance programs as part of local development agendas to assist women in coping with the effects of increasing unstainable energy consumption, particularly in the context of developing urban regions. Yet there are many unanswered questions in this area and the research reported in this article aims to increase our understanding in this field. What the main capacity-building priority areas are and how valuable they are for women, are some of the questions that will be addressed in this article. Identifying and improving core capacity-building areas seems from this study to be the most effective way to enhance the ability of women to cope with pressing sustainability challenges over time. Based on stakeholders' perceptions in two case studies, this articles pays attention to the nature and importance of these capacity-building priority areas.

This article also explores existing capacity-building approaches to assist women in protecting their assets and capacities and reverse the effects of unsustainable energy consumption. Scholarship debates show that capacity-building has been a subject of analysis by scholars from various disciplines like education, economics and more recently sustainable development. Coined as a long-term process to strengthen individuals' and organizations' skills to solve problems and achieve objectives, the notion capacity-building for women has been well covered in the literature; however, there are few scholars who deal with its impact to reverse unsustainable energy consumption at the local level. Although the subject of capacity-building is appealing from a rhetorical standpoint, yet at the community level, these initiatives appear to have achieved a very low level of impact, particularly for women. However, why this is the case has not been explored extensively. This research gap needs further exploration, specifically in developing contexts, where capacity-building for women is essential in the face of escalating sustainability issues. Hence, it is necessary to explore the current state of existing capacity-building approaches. In addition, it is necessary to investigate the actual level of achievement of these initiatives, to identify barriers to their impactful implementation in local development agendas and to recommend ways of overcoming these barriers, so that stakeholders can play a stronger role in assisting women build resilient assets and reverse existing unsustainable practices at the local level.

Following a top-down approach, global mandates encourage local stakeholders to deliver capacity-building to assist women in coping with the effects of unsustainable energy consumption patterns. However, these actions are often disconnected to the local context or irrelevant for locals. Yet at least from a preliminary investigation of the situation, these initiatives appear to have achieved a very low level of impact. This articles argues that capacity-building priority areas are those valuable for women and the contexts they are immersed. The focus of this research is to identify and investigate the actual level of impact of existing capacity-building initiatives, and recommend priority areas, so that stakeholders in the case study locations can play a stronger role in helping women boost their assets

towards sustainable energy consumption practices. Following a qualitative methodological approach, this article compares two cases in Latin America and Asia and the Pacific.

# Evaluation of long-term urban transition in a megacity based on alternative socioeconomic pathways

Miho Kamei, Kiyo Kurisu, Keisuke Hanaki

There has been significant concern about how climate change policies can be integrated into real practices and implementation plans. Urban planning is an important method of realizing low-carbon built environments. However, although integrating urban planning to achieve sustainable and low-carbon cities is strongly motivated, a methodology of developing environmental policy oriented towards long-term master planning has not been practically established.

The authors have previously developed socioeconomic pathways for the urban scale and focused on Tokyo as a case study (Kamei et al., 2016). Based on Tokyo's socioeconomic pathways, this research shows the next step of quantitatively analyzing future building stocks and carbon emissions from buildings in Tokyo.

## Research Methodology

First, we tried to find a significant explanatory variable which may influence the building scrap rate. Second, we analyzed the trend in the average lifetime of buildings. Third, using significant explanatory variables, we estimated changes in future building stock changes, which includes an analysis of future demand. Finally, we estimated carbon emissions in line with three socioeconomic scenarios. The parameters are explained, including their basis in the narrative scenario and the theoretical framework from the previous paper.

Tokyo's long-term socioeconomic pathways include three alternative futures: the business as usual (BAU), local vitality, and efficiency scenarios. The major differences among these three alternative scenarios are the transition of urban forms, the density of each urban cluster, building stock changes (demolishment/renovation/new development), and people's lifestyle changes accompanied with social and economic transitions.

## Building Lifespan Analysis

Analyzing a building's lifetime requires a large, efficient data base of buildings; specifically, data on the period when buildings were built are significant. These data can be used to analyze the building scrap rate, survival rate, and accumulate survival rate. We applied a COX hazard model to examine some possible explanatory valuables. The economic growth rate was recognized as the most efficient explanatory variable; thus, we applied the economic growth rate from each scenario to estimate future. We compared the results of economic growth rate in different years. The three-year economic growth rate (previous year/present year/next year) was recognized as the most relevant fit to the real building scrap rate data.

## Future Projections of Building Stock

In the projection, the three future scenarios played a significantly important role in estimating changes in the building stock. The key parameters, such as population and economic growth rate, came from the scenarios. Figure 1shows the existing building stock changes by 2050 that were estimated by applying the COX hazard model with projections of economic growth rate set at 1 percent (BAU scenario) and 2 percent (local vitality and efficiency scenarios). Future

building demands were estimated from the perspective of each scenario's settings, which allowed new building stock to be projected for each scenario.

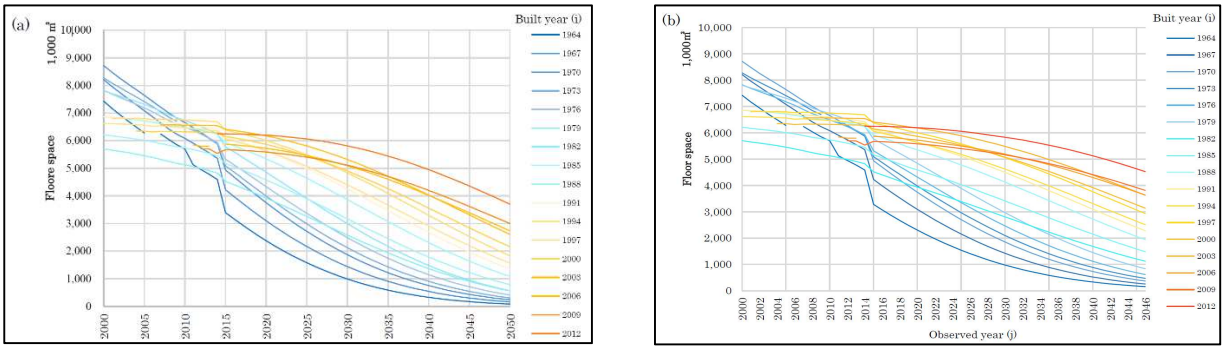


Figure 1: The projection of Floor space changes in existing building stock by 2050 : wooden building
(a) BAU scenario, (b) Local Vitality scenario, (c) Efficiency scenario

**Evaluation of Carbon Emissions**

Finally, the carbon emissions in three alternative scenarios have been evaluated. Some parameters such as populations and economic growth rate were referred from scenario story lines. In addition, the emission factor for each scenario was set by referring both the conditions of scenario story lines and existing research results.

**Thailand's renewable energy transition from utility-scale project to residential technological adoption**

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In Southeast Asian region, Thailand is by far the most active country in terms of renewable energy (RE) policy support and technological adoption. Owning very much to its electricity supply industry reformation after the Asian financial crisis in 1997, Thailand's electric sector has been extended from government monopoly to market liberalization which is then accommodated the proliferation of RE projects. Even though a series of RE policy modifications was implemented to incorporate the rapid changes from both domestic market and global phenomenon, the lack of policy integration urged on policy alignment and in 2015 Th*ailand Integrated Energy Blueprint* was approved to promote RE and utilization energy conservation for long term plan during 2015-2036. Yet, RE plans have suffered complexity in the implementation and multiple policy revisions. The summary of the RE plans, potentials, targets and achievement as of end-2015 is elucidated in Table 1.

Table 1 Summary of Thailand's renewable energy potential, planned target, and status as of end-2015

| *(Unit: MW)* | **Total Potential** | **Target** | | | | **Current capacity* (Dec 2015)** |
|---|---|---|---|---|---|---|
| | | REDP 2008-2022 | AEDP 2011-2021 | AEDP 2011-2021 (revised in 2013) | AEDP** 2015-2036 | |
| **Biogas** | 657.58 | 120 | 600 | 3600 | 1280 | *372.51* |
| **Biomass** | 8492.01 | 3700 | 3630 | 4800 | 5570 | *2726.60* |
| **Hydro – small** | 410.00 | 324 | 1608 | 324 | 376 | *172.12* |
| **Hydro – large** | 2906.40 | | | | 2906.40 | *2906.40* |
| **MSW** | 697.01 | 160 | 160 | 400 | 550 | *131.68* |
| **Solar PV** | 42356.67 | 500 | 2000 | 3000 | 6000 | *1419.58* |
| **Wind** | 14141.00 | 800 | 1200 | 1800 | 3002 | *233.90* |
| **Others*** ** | | 3.50 | 3 | 3 | | |
| Total | | 5607.50 | 9201 | 13927 | 19684.40 | *7390.60* |

*Note: *Current RE generation included off-grid power generation;*
***AEDP 2015-2036 includes the existing large hydropower*
****Others type of energy i.e. hydrogen*
*REDP Renewable Energy Development Plan*
*AEDP Alternative Energy Development Plan*
*Source: DEDE (2016) Thailand PV Status 2014-2015 [Online]. Available from: http://energy.go.th/energy_data.html*

Thai government encouraged RE technological adoption and provided generous incentive through the Adder programme since 2007 - which applied for six RE technologies i.e. biogas, biomass, hydro, municipal solar waste (MSW), solar photovoltaics (PV), and wind energy. Adder programme is designed to secure a significant amount of upfront investment, and consequently led to the dominance of utility-scale project, particularly in solar PV sector. In 2010, the Adders' rates were reviewed and adders for new solar PV projects were no longer offer.

From national and international perspectives, however, more diversified and decentralized projects should be prioritised, with more public awareness and engagement. Thus the Feedin Tariff (FiT) programme in 2013 helped encourage RE technological adoption in residential sector and piloted for biogas, solar PV for rooftop and solar community projects. Still, financial

burden to society was amongst leading issues which capped RE installation potentials. The paper aims to explore two perspectives. First, what policy and measure have been deployed to encourage RE technological adoption and to what extent those mechanisms have achieved in comparison to the conventional power plants given Thailand's political context where policy-makers attempt to legitimise the expansion of coal-fired power plant to secure national growing energy demand. Through the lens of RE policy support development and RE technological adoption, solar PV technology—amongst alternatives—exhibited the highest market growth with a cumulative installation capacity of 1419.58MW by 2015, and 2309.84MW by 2016. It is noteworthy that solar PV projects bloomed not merely from national policy support in 2007, but together with the significant global PV module price reduction from 2008 onwards. Hence, the second perspective is an in-depth analysis of solar PV adoption which will enhance the understanding of PV project development and how future policy design can foster further PV adoption particularly in residential sector. Based on my recent PhD research findings, the dominance of utility-scale project in Thailand is intriguing with more than 97% of 2309.842MW PV operating capacity in 2016. Furthermore, the analysis covers PV installation transition and policy impacts on four aspects: financial burden on society through power tariff structure, PV project location, dominant market players, and investment models.

Besides RE policy review and statistical analysis, the methodological framework is based on sectoral systems of innovation having three key elements of knowledge and technology, actors and networks, and institutions. So that a better understanding of PV industry structure, dynamics, and transformation can be discerned. Methods used for gathering, collating, and analysing information cover both primary and secondary sources based mainly on official documents and other related publications. Nonetheless, inputs from key informant interviews, field observation and previous workshop engagement provide insights and complementary details to the analysis.

**Renewable energy deployment in Uzbekistan: wind/solar power development**

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Uzbekistan is an emerging economy in the heart of Central Asia, with a territory of 447,400 $km^2$ and a population of about 32 million. Tashkent, the capital city, is the most densely populated city in Uzbekistan, with an official population of over 2 million people, though this could be as high as 4 million, as there are many unofficial residents (World population review, 2017). Despite possessing substantial reserves of energy resources, a steady rise in domestic consumption could result in the country suffering electricity supply shortages after 2020. The issues of diversifying energy resources and seeking new alternative sources for energy are widely discussed in Uzbekistan, both by public officials and energy experts. The government appears to be willing to improve the situation, and is committed to increasing energy efficiency in all sectors of the economy and to accelerate the development of renewable energy sources. The development of such sources would diversify the electricity generation mix, lead to large scale reduction in $CO_2$ emissions, while also reducing the country's high reliance on natural gas. Diversifying the electricity production system to include more renewables (e.g. solar and wind) could help to increase energy security and reduce the risks to Uzbekistan's power sector.

Despite their potential and benefits, the use of renewables in the country is currently insignificant. Solar and wind power have the highest potential amongst the range of possible renewable energy sources, given the climatic and geographic conditions of the region. It is thus important i) to study economic feasibility of RES projects in Tashkent region; ii) to identify policy related factors that affect project and sector economics.

To address the first objective, the feasibility of wind and solar power stand-alone energy systems was assessed using the HOMER software, using real meteorological data for the Tashkent region. Two groups of indicators were utilized to assess the optimal composition of an energy system for small villages in the region: economic indicators (Net Present Cost, Levelized Cost of Electricity) and environmental indicators ($CO_2$ emission, fuel consumption).

The second objective includes the study of policy related aspects and legislative framework development in the renewable energy sector. Preliminary findings indicate the present "Program on Further RES Development" adopted on May 26, 2017 lacks many important policy components, such as generation-based policies for renewable electricity and other financial incentive mechanisms. The introduction of feed-in-tariffs that are attractive for individual producers of renewable energy would allow to substantially improve the economic attractiveness of such systems, allowing excess power to be sold to the grid and decrease the storage capacity requirements. Moreover, the current electricity tariffs in the country remain low (0.05USD/kWh), making RES deployment comparatively expensive. Finally, the authors investigate changes to government policy that are recently taking place in the country, and question the consistency of such changes with the course taken towards increasing the share of renewables in power generation.

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**Cooperation and forecasting of solar energy technologies applied to Japan and Brazil**

*Alex Fabianne de Paulo, Geciane Silveira Porto*

The challenge to mitigate the environment degradation, mainly related to climate change, has led to an increase in interest about mechanisms to encourage the development and adoption of green technologies (Hall & Helmers, 2010). In this context, innovation fostering and development of green technologies essentially becomes important and necessary for environmental and business sustainability (OECD, 2011). One of the greatest potential for green technologies refers to the exploitation of energy through the use of solar radiation since it is a clean and renewable resource (Dong et al., 2012). The impact on the disruptive technologies development such as solar energy that proposes to change the energy matrix can also influence positively all innovation ecosystem and bring environmental, financial and social benefits (BID, 2014).

However, what are these major technological trends on solar energy from Asian and Latin Americas countries? Trends identification can be made using different methods quantitative, qualitative or mixed. One of these ways is based on tracing the most promising technological routes analyzing patent citations whose principle is that a patent cited several times tends to get greater technological impact and can generate complementary technologies in a particular technological area (Verspagen, 2007). Studies about patents technological route, with the difference to be more qualitative, resembles bibliometric techniques that calculates index of citations per patent, and the most cited patents are considered the most relevant one.

In addition, are these most relevant technologies protected on Asian and Latim Americas countries? Is there any cooperation for solar energy technological development and what is the profile of cooperation efforts? Companies are actually looking for more frequently to collaboration with universities and research centers, and there is a notable increase in the technological cooperation and know-how exchange between the companies (Etzkowitz & Leydesdorff, 2000). The strategic importance of exploring potential technology partners has been marked in recent years because of growing trend of collaborations for innovation across organizational boundaries (Petroni; Venturini & Verbano, 2012). Thus, technology cooperation tends to be a mechanism to find the key players and influencers to a technology type as well as it can help to accelerate technological development (Abulrub & Lee, 2012).

For the energy sector, some studies describe collaboration features in technological development. Huang, Dong and Chen (2013) analysed solar energy cooperation and proposed International Collaboration Activity Index. Others researches have used bibliometric analysis to explore scientific collaboration patterns (Wang et al., 2014a). Some studies using patents to assess collaboration standards of solar power industry have also been published after 2010 (Lei et al., 2013; Wang et al., 2014b). All these researches have focused on identifying collaboration patterns, but they did not show in greater depth the relationship between main players and technologies. Futhermore, current studies do not address features such as interest in technological development and market protection nor more relevant technologies. Based on this gap, this paper proposes a patent analysis of technology cooperation and relevant solar energy technologies. Also, it will be providing a technological outlook for Asian and Latin American countries and relationship between them and with other countries.

This study uses solar energy patents applied between 1997 and 2016 in the main patent offices around the world. It uses patents from Derwent Innovation database according to IPC Green Inventory. The methodology is based on Social Network Analysis (SNA) technique. This method is a powerful approach to get answers about behavior between individuals or organizations as well as for understanding patterns and key influencers from the subject (Wasserman & Faust, 1994). SNA depicts the interaction between players. The technique can be used to analyze a different range of variables, such as relationships between companies and universities, the spread of a disease, which languages spread faster, the social position of an individual and their professional opportunities, among others (INSNA, 2016).

In this paper, a cooperation proxy is adopted to patents which has more than one assignee. Thus, patents with a single assignee can be assumed to be developed exclusively by their assignee without any cooperation. Common functions in SNA such as degree, betweenness and closeness centrality, giant component, modularity, eigenvector centrality and pagerank will support to identify key assignees and still map technological cooperation networks of Asian-LATAM solar energy patents. Also, patent citations are used to point out the most relevant and promising technologies of solar energy. This method offers resources for both qualitative and quantitative analysis as published by Fontana, Nuvolari and Verspagen (2009). Nodes of solar technologies network are represented by patents and their connections are given by backward citation. It is assumed that these patents have a technological connection with those who cite them. By analyzing citations made by a particular technology can be found "main paths" to become a patent and on a larger scale, it can define the main trajectories and most relevant technologies (Porto & Kannebley Jr, 2012). The use of the SPLC algorithm (Source Path Link Count) helps to find the routes and the most promising technologies on solar energ

Results will provide a better understanding of solar energy innovations applied to Asian-LATAM countries. Its trends, promissing technologies, cooperation features and market interesting will be obtained by patent database and network analysis. Mapping these issues can support governments, companies and universities from Asian-LATAM in their decisions about solar energy applications, offering data of most relevant technologies, their owners, relationships, as well as their marketing protection coverage through reliable and replicable metrics. It enables an analysis of competitive technological intelligence and can be used as a tool for decisions of future efforts and investments. Also, companies can observe in a simplified way, standards that are followed and adopted by scientists and market, bringing a possibility of increasing technological knowledge that previously had only empirical means. In addition, Asian-LATAM government can understanding dynamic of solar energy development from/to their countries and propose polices that improve use of solar energy in urban environment.

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**Bioenergy Potential from Agricultural Residues in the State of São Paulo, Brazil (Preliminary Analysis)**

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Biomass sources including agricultural and forest residues, livestock wastes, dedicated plantation for energy, and the organic part of waste streams (biogas, landfill gas, municipal solid waste, etc.) currently corresponds to 5876 MW in the São Paulo State of Brazil (SPSB). Such numbers show the importance that bioenergy from biomass assumes in this region, being reflected also in terms of the planted agricultural area. In fact, the SP State has 10 million ha of native (about 1.5 million ha) and planted (about 8.5 million ha) pastures, an area that coexists with an agricultural area that involves the production of grains as rice, beans, corn and soybeans (1.7 million ha), sugar cane (4.2 million ha), coffee (220 thousand ha), among others (Goldemberg, Nigro and Coelho, 2008). Furthermore, the context of the SPSB has several urban poles and one megacity, the city of São Paulo, which today has 21.4 million people covering an area of 7.947 $km^2$, where the total amount of wastes produced daily reaches the 4690 – 7500 Mg (CETESB, 2016; Zhao *et al.*, 2017). Under such contexts, many potential biomasses can be reused for the production of bioenergy, since biomass has a significant potential to be used for sustainable energy needs, being also a way to address some of the conflicts concerning land, food, energy and water (WFEL) under both rural and urban systems as well as to promote higher efficiency on using WFEL resources and achieve Sustainable Development Goals (SDGs) in the region.

The Water-Energy-Food Nexus is being promoted as a conceptual tool in order to achieve SDGs. Other important sectors such as minerals, livelihoods, wastes, political intervention and land sectors are equally relevant for the same discussion and to achieve the same objectives. In fact, and in detail, most of the SDGs depend directly or indirectly from land resources, since land is needed not only for the production of food, but also for the production of energy (biomass for bioenergy), and for water supply. As a result of growing natural resources scarcity, nowadays observed and described in several disciplines, the inter-connectedness existing among water-energy-food-land (WELF) sectors has become evident, being now necessary to study which influences and synergies occur when some action is taken on a particular sector (Taniguchi *et al.*, 2017).

The SPSB heavily invested in money and policies promoting the research, the production and commercialization of bioenergy crops mostly for biofuels, in answer to the dramatic increasing in oil prices, to global mobilization and industrialization, to the finite nature of fossil energy sources, to the increasing pressure on natural energy reserves, to the awareness that the supply and security of petroleum-based materials is diminishing, and also to achieve energy independency. Nevertheless, many of those political decisions and the models of production implemented lead to several not calculated WELF conflicts, since not always policies concerning water and land protection and utilization were developed thinking on the inter-connectedness that exist among all WELF sectors.

Therefore, the aim of this work is to propose a way to carry out a Water-Food-Energy-Land Nexus assessment approach in order to understand the existing interactions between water, energy, land and food systems concerning the use of biomass for bioenergy on the context of the SPSB. Indicators concerning the WELF sectors will be collected at the national and sub-national levels or built when information lacks, and then used to perform a qualitative analysis and a quantitative WELF NEXUS assessment, in order to return response options concerning the best strategic visions, policies, regulations, institutional settings and interventions concerning the region of SPSB. A rapid nexus appraisal will be performed in order to perform the context analysis on the bio-economic pressures on the WELF aspects, and indicators concerning capital and labor will be included. Then, the following interventions will be considered for the SPSB: 1) the production of bioenergy crops in the SPSB; 2) the reuse of wastewaters in energy agriculture in the SPSB; 3) the reuse of municipal wastes and their potential for the production of bioenergy in the same region. For each intervention, reference values and values existent for the SPSB will be compared and scores will be built taking into consideration that the same divergence from the reference value means the same score, according with the FAO Nexus methodology (FAO, 2014). All the aggregate scores for each WELF sector will be presented graphically for each intervention and then the interventions will be compared among them. Furthermore, data concerning the status, the pressures, expected demands, trends and drivers on natural resources and socio-economic aspects on the SPSB will be collected from different case studies and data basis, and for each intervention the information will be organized in the form of a strengths, weakness, opportunities and threats (SWOT) analysis. Special attention will be also given to the environmental and socioeconomic concerns, such as GHGs emissions, energy and nutrients balances, impacts on biodiversity, soil quality, water use and landscape sustainability.

**Key-words:** Urban and rural biomass; Bioenergy; Water-Energy-Land-Food Nexus; SDGs.

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**Options and limitations for road transportation in urban areas and megacities in a carbon constrained scenario**

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The urgency for addressing climate change as well as the need for increasing the efficient use of natural resources are the main foundations for the construction of an environmentally, economically and socially sustainable society in a near future. The energy sector corresponds to two thirds of the global green house gases emissions [1] and, therefore, a fully sustainable energy supply has to be implemented. Due to its least-carbon intensive energy matrix, as well as a broad range of renewable energy resources and low-carbon development initiatives, South America has a huge potential for leading the world transition to this new energy system [2]. Among the countries of South America, Brazil is the biggest country in terms of population and territory and, consequently, also in electricity demand. As a significant increase in population and electricity demand are expected in the years to come, as well as the migration of more people to urban and industrial areas, the development of a fully renewable energy system in Brazil is of vital importance for establishing clean development strategies and for helping in the mitigation of climate change. In addition, because 68% of the installed capacities in the power sector in the country are hydropower plants [3], the need to reduce the vulnerability of the electricity system to a changing hydrological regime is evident.

Previous studies have shown that an energy system based on 100% renewable energy systems for Brazil and South America in the year 2030 is not only feasible but is also the least cost solution when compared to business as usual options [2,4]. Thus, the implementation of such a system is a question of political will. In the last few years, different initiatives of the Brazilian government have increased the installation of renewable energy technologies in the country. Among them are the program to incentivise alternative electricity sources (PROINFA) launched in 2002, a feed-in tariff that was part of 2001 PROEOLICA program, and different laws, decrees and resolutions, and import and state tax exemptions [5]. However, the pace at which new renewable technologies, especially non-hydro power plants, are inserted in the Brazilian energy mix is still very slow considering the potential of the country for renewable energy generation and the need for decreasing the vulnerability of the power system to a changing hydrological profile.

In this context, this paper aims at: (1) making a brief review of the policies and initiatives that have contributed to the development of renewable energy technologies, especially non-hydro power plants, in Brazil in the last few years; and (2) suggest new policies that are capable of boosting the development of these technologies. The methodology consists of three different steps. Step 1 consists of the collection of data regarding the installation of new renewable energy power plants in Brazil in the last few years. In step 2, an analysis of the actors (i.e. solar cooperatives and renewable energy related companies) and policies (i.e. dedicated renewable energy auctions, feed-in tariffs, tax exemptions, funding opportunities and market) that have contributed for increasing the share of renewable energy technologies

in the Brazilian energy mix is developed. Finally, in step 3, the main barriers for the development of renewable energy systems in the country will be mapped and future policies for tackling these barriers will be presented.

Preliminary results were already obtained and are described next. Fig. 1 presents the added installed power plant capacities and Fig. 2 shows the total installed power plant capacities in Brazil until the year 2014. From the figures it can be observed that the energy mix of the Brazilian power sector is one of the most sustainable globally, and it has been mainly constituted by hydropower plants. In the early 2000s, with the changes in the Brazilian electricity regulation and the electricity shortage crisis in 2001, more non-hydro power plants started to be added yearly to the system. A significant number of gas and biomass power plants has been installed, supplying electricity in peak demand hours and diminishing the probability of electricity shortages in the country. From 2011 to 2014, however, there was a significant increase in wind turbines capacities, being a maximum number of wind power plants reached in the system in the year 2014. In order to understand this fact, a brief analysis of the energy policies for this period can be done and it shows a correlation between the policies implemented in the sector and the added wind installed capacities. In 2011, the Decree 7660 stablished the implementation of import tax exemptions for wind power equipment in Brazil and in 2014, the Law 13097 provided tax import exemptions (PIS/COFINS) for wind turbine components. Both initiatives have boosted the installation of wind turbines in Brazil, especially in the Northeast part of the country, as can be seen in Figs. 1 and 2.

From the preliminary results, it can be concluded that the development of policies for the energy sector is directly related to the installation of new renewable energy capacities in the country. New policies that consider tax exemptions, hybrid renewable power plant remuneration, loans for PV prosumers and the implementation of carbon taxes are future policies that can help Brazil to move towards a fully sustainable and renewable energy system. In the next stages of this study, a deeper analysis of the Brazilian energy system and of the main policies and initiatives that can foster the implementation of renewable energy systems in the country will be developed and discussed.

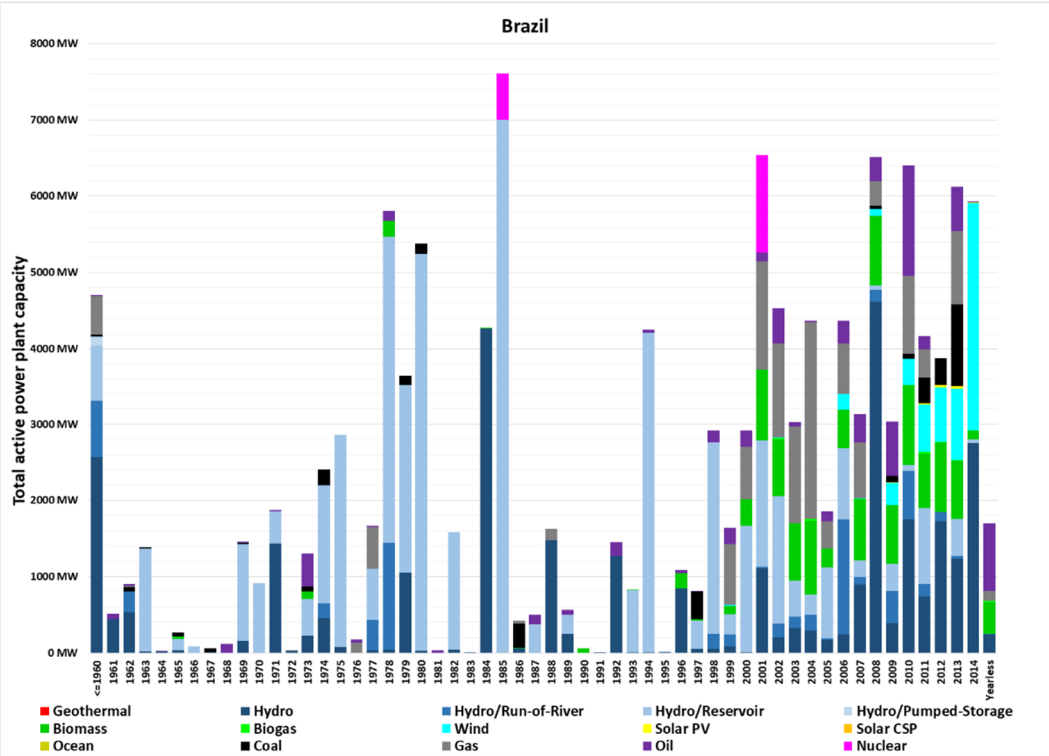


Figure 1. Added power plant installed capacities in Brazil.

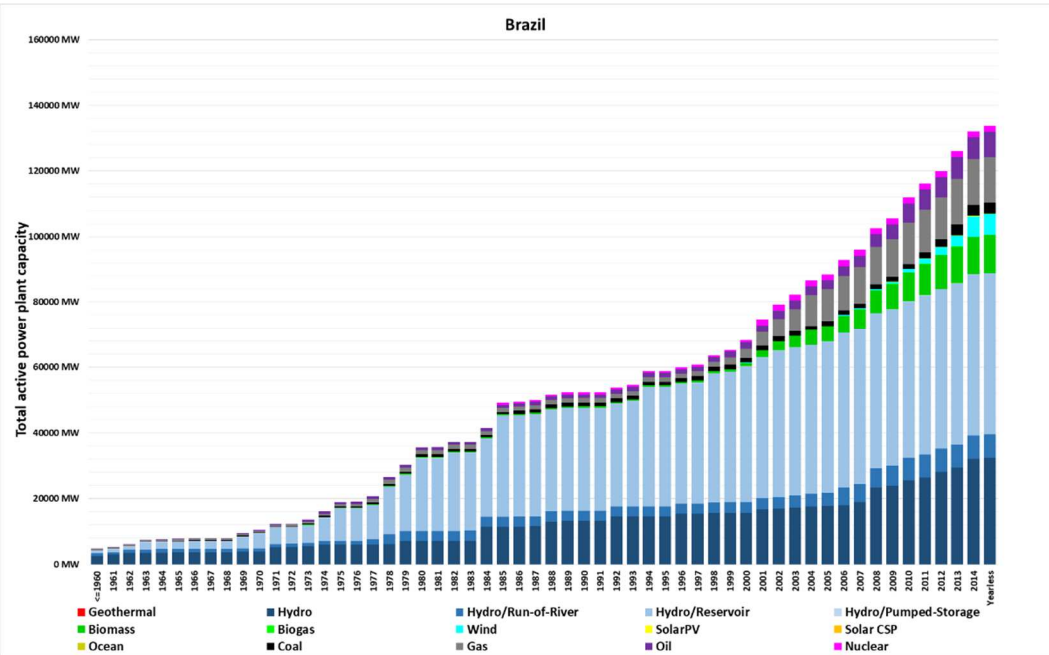


Figure 2. Total power plant installed capacities in Brazil.

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**Measuring Externalities in an Information Commons**

**The Case of Libraries**

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The present paper measures external effects in a specific type of common-pool resource, an information commons. Employing a novel dataset related to more than 700,000 transactions in distinct libraries during a 10-year period (2006-2015), I estimate the impacts of actions of library users who were subject to a non-monetary sanction over users who were subject to a monetary sanction. Additionally, I estimate peer effects among users, considering the number of items they borrow from the library. When investigating external effects, I uncover a "crowding-out" effect: for an additional unity in professors and employees' counts, there is an approximate one-to-one decrease in students' counts. In the case of peer effects, I find that a rise in the borrowings of a user's peer group correlates with her own borrowings, an evidence of positive peer effects.

Common-pool resources correspond to goods with unique characteristics: they are non-exclusive, but rival. The first property states that it is hard to exclude individuals from consuming the good, while the second property states that one individual's consumption may reduce other individuals' consumption. Examples of common-pool resources are fisheries, forests and irrigation systems, just to cite a few (Dietz, Ostrom, & Stern, 2003; Vollan & Ostrom, 2010). One important question related to this class of goods asks if their characteristics may lead to overexploitation. In a seminal contribution, Hardin (1968) predicted that such a situation would inevitably happen, given that individualistic attitudes might prevail in both the short and long run. For example, forest degradation would be a natural result in a setting where individuals and firms try to maximize their own private gains, the so-called "Tragedy of the Commons"[2].

The present paper measures externalities in a specific type of common-pool resource, an information commons. Employing a novel dataset related to more than 700,000 transactions in distinct libraries during a 10-year period (2006-2015), I estimate the external effects of the actions of library users who were subject to a non-monetary sanction over users who were subject to a monetary sanction. Additionally, I estimate peer effects among users, considering the number of items they borrow from the library. In both occasions, I exploit the fact that libraries are an example of a common-pool resource, with an emphasis over their basic properties. I also exploit differences among users in terms of the incentives they face: while some users (professors and employees) are subject to non-monetary sanctions – in the form of daily suspensions – others (students) face monetary sanctions, in the form of fines.

Libraries constitute an ideal setting for studying externalities. The existence of a limited supply of books in a library at a given moment may generate competition among users, as well as congestion. The constant interaction among users with similar needs, such as students from the same class, allows a researcher to estimate peer effects in such a context. Given common-pool resources' rivalry property, one can imagine that, the higher the number of books that a

[2] Coase (1960) corresponds to a seminal contribution in social dilemmas, with an emphasis on situations involving what the author calls "social cost problems". Olson (1965), Samuelson (1954), and Tiebout (1956) correspond to pioneering references related to public goods, while Hardin (1968) and Ostrom (1990) correspond to discussions related to common-pool resources. See Buchanan (1965) for a classical treatment of club goods.

particular user borrows, the lower will be the number of available books for remaining users. In a library setting, students from the same class, facing exam weeks, could compete for the same books. Following the same reasoning, professors from similar areas, preparing course materials before the semester begins, could face competition for library services from their peers. These features of the data allow me to study externalities in this setting by: (i) estimating the external effects of users' actions, considering that they face distinct types of sanctions, and (ii) estimating peer effects among users with similar characteristics.

I anticipate two main results. First, when investigating the external effects of professors and employees' book counts over students' counts, I uncover a "crowding-out" effect: for an additional unity in non-students' counts, there is an approximate decrease of one-to-one in students' counts, *ceteris paribus*. Although these estimates do not have a causal interpretation in the present setting, they correspond to an empirical estimate of the magnitude of libraries' rivalry property. Second, when estimating peer effects among users with similar characteristics, I find positive peer effects: for every 100 books borrowed by a user's peer group, there is a rise of three books per user. Taken together, these results stress the importance of behavioral complementarities in a field setting, having important implications for theories based on common-pool resource management, and public goods provision.

The results reported in this paper have direct implications for organizational behavior issues, such as team management and incentive schemes. In terms of team management, a traditional question in organization studies relates to the impossibility of measuring distinct members' contributions in teamwork, given the possibility of free-riding behavior (Alchian & Demsetz, 1972). While this paper is focused on a very specific setting (a university library), it does shed light on differences related to group behavior over time. In terms of incentives, the present paper reports heterogeneous behavioral responses among library users, when considering the distinct types of sanctions they face over time. These results call attention to the importance of incentives in social dilemma situations in organizations. Specifically, they suggest possible complementarities between different sanctions in social dilemmas. For instance, when dealing with situations similar to common-pool resources' management, decision makers could think about using gradual monetary sanctions as a means to induce behaviors that could benefit the organization as a whole.

**A case study of climate change adaptation governance in Peshawar Valley of Khyber Pakhtunkhwa, Pakistan**

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The significant contribution of energy toward economic growth and improvement of quality of life of citizens is well recognized. Increasing demand of energy due to population and industrial growth, urbanization, and depletion of conventional energy reserves forced the experts to think and to address the energy insecurity challenges especially in urban areas of the world. Proper use of energy is vital to cater the need for energy demand. Cities and urban centers have an important role to tackle the energy insecurity challenge by properly utilizing the alternative and renewable resources of energy. In 2015 at the Paris City Hall more than 700 city leaders from around the world committed to have 100% renewable energy by 2050. Pakistan stands as a most vulnerable country, in term of the consequences of climate change and its impact on available energy sources. Energy is a prerequisite to generate economic activities and it is a biggest determinant of development and economic growth. Presently, the energy scarcity in Pakistan has caused massive productivity and employment losses.

Pakistan's energy crisis has troubling implications for its fragile economy. The energy shortage has cost Pakistan upto 4% of its gross domestic product (GDP) in recent years. Hundreds of factories (including more than 500 in the industrial hub city of Faisalabad alone) have been forced to close. The current gap between the demand and production of electricity in Pakistan is approximately 5000–8000 MW.

Faisalabad is the third largest city in Pakistan and second largest in Punjab. The GDP of the city is expected to be around USD 87 billion by 2025. The energy demand is increasing day by day due to urbanization and economic growth in Faisalabad. However, the city is increasingly facing the challenge of energy scarcity. Pakistan is one of the few developing countries with a nationwide electricity transmission grid and pipeline based gas distribution infrastructure. It is pointed out that around 60% of the total electricity is consumed by Punjab province only due to its larger size and developed industrial sector. Most of the consumption comes from household demand or domestic use majorly in cities which is followed by commercial use.

To meet the challenge of the energy insecurity, Pakistan has established energy related policies and action plans during last one decade. Keeping in view the current and future challenges of energy security especially in cities areas due to urbanization and industrial growth, the focus of proposed measures is to utilize sustainable energy resources. The exploitation of these alternative resources of energy will ensure energy sufficiency and sustainable development in the country. The utilization of these alternative resources of energy is also an important response to climate change.

Pakistan is blessed with renewable energy resources such as wind, solar, hydro, and biomass. These renewable resources can play an instrumental role to curb energy crises and to ensure the sustainable energy development of the country. Renewable energy sources can help to mitigate climate change and tackle the energy crisis in the country. Multiple policy actions and strategies are established in place to support the development and effective utilization of renewable sources in the country. However, it is yet to effectively implement the proposed policy initiatives to address the energy crises and to attain the sustainable energy mix in the country including the Faisalabad city.

Energy issue is more governance issue rather than the financial one. The purpose of this study is to investigate the key challenges for effective energy governance in Faisalabad, Pakistan. Additionally, the study will explore the prominent adaptation strategies to energy security in the city. The study contributes to understand the dynamics of energy governance from a major urban city of Pakistan. The findings of the study provide valuable inputs to policy makers and energy experts for devising further action plans.

The study finds that top-down approach makes difficult to implement the proposed policy measures. Poor coordination and cooperation between governmental agencies and related departments is other reason for not implementing the policy actions with its true spirit. The initial investment cost, poor infrastructure, lack of capacity and training, and lack of social awareness & acceptance are some of the major barriers for effective energy governance challenges in Faisalabad.

On adaptation front some strategies are identified: less use of electricity, adjustments in cooking practices, and adjustments in sleeping schedules. Furthermore, for saving the energy, time duration is specified in industrial sector. The government provides incentives to the industrial sector and households for use of energy as per specified time duration. The public awareness campaign has been launched to educate public about adaptation measures.