Nexus Dialogue on Water Infrastructure Solutions

Building Partnerships to Optimise Infrastructure and Technology for Water, Energy and Food Security

Symposium Report

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Acknowledgements

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Executive Summary

Water, energy and food systems are inter-connected and have become increasingly more complex and dependent upon one another. As a result, a disturbance in one system can destabilise the others - highlighting the need for a 'Nexus-Based Approach'. This requires the water, energy and food sectors to engage in a dialogue and deliberative analysis of river basins, looking for solutions to optimise the inter-dependencies and support the equitable and sustainable allocation of natural resources while balancing environmental, social and economic issues.

The Nexus Dialogue on Water Infrastructure Solutions has successfully organized a series of regional "Anchor" workshops in Africa, Latin America, Asia (with UNESCAP[1]) and Central Asia (with EastWest Institute[2]) since 2013. The most recent Nexus Dialogue event was a Symposium held in Beijing, China on 13-15 November 2014, in partnership with Global Water Partnership China (GWP China[3]). Participants were drawn from across the world from the water, energy and food sectors. The Nexus Dialogue Symposium provided an opportunity to identify the problems and solutions to secure water, energy and food security, both across and within Asian river basins. Also, the Symposium produced a set of recommendations, which established policy principles for sustainable water infrastructure operation, management and optimization in the nexus.

The purpose of the symposium is to share and discuss experiences of the water-energy-food nexus in China, and across the world. The Symposium presented learnings from previous Nexus Dialogue workshops in African, Latin American, Asia and Central Asia and focused on the implementation of solutions for water, energy and food security in the region. Symposium participants were encouraged to identify where the barriers to implementation exist, and look at where and how these have been overcome.

The objectives of the symposium were to:

- Learn from workshop participants about their nexus challenges
- Support participants in establishing coordinated nexus roadmaps
- Understand how to scale up nexus solutions
- Prepare for the final Nexus Dialogue event at the 7th World Water forum in South Korea

A number of emergent themes came out of the symposium, these included:

1. **Clean technology (Cleantech) for water, energy and food infrastructure solutions**

This theme focused on the use of Cleantech across water infrastructure systems that support the water, energy and food sectors, which involved topics likes wastewater treatment, hydropower, natural infrastructure, closed loop technologies, and environmental engineering – mobilising rapidly growing areas as providers of nexus solutions.

2. **Using the nexus to accelerate social development and support water stewardship and corporate engagement**

This theme focused on social and economic development approaches, including corporate sector engagement in linking water, energy and food security and accelerating infrastructure development across scales.

[1] http://www.unescap.org/
[2] http://www.ewi.info/
[3] http://www.gwp.org/en/GWP-China/

3. **Influencing pathways of investments in the nexus**

This theme examined money flows channeled into infrastructure and technology especially in emerging economies, and the factors influencing the pathway of these investments to resource water-energy-food nexus solutions.

4. **Natural infrastructure/ecosystems in the nexus**

Theme 4 sought to promote better understandings of the importance of healthy ecosystems in well-functioning infrastructure built for irrigation, hydropower or municipal water supply, and in achieving the economic returns necessary to justify investments.

5. **Power dynamics (policy and institutional change/collaboration) across the nexus**

Theme 5 gave special attentions to current and future policies for sustainable water infrastructure operation, management and optimization in the nexus, with the expectation of moving cross-sectoral discussions to implementation mode, focusing on improving the enabling environment to ensure that collaboration and joint solutions lead to shared benefits.

Participants from the Beijing Symposium were encouraged to build new coalitions and partnerships for follow-up action in technology, demonstration and investments in built and natural water infrastructure and national-level dialogues on policy and implementation. The symposium was also a preparation for the next step--the final Nexus Dialogue event to be held at the 7th World Water forum in Daegu and Gyeongbuk, South Korea, 12-17 April, 2015.

1. Introduction

The Symposium on Infrastructure Solutions in the Water-Energy-Food Nexus was convened from November 13th to the 15th, 2014 in Beijing, China by the International Union for the Conservation of Nature (IUCN), the International Water Association (IWA) and the Global Water Partnership China (GWP China). The Symposium brought together over 80 people from across China and the world, to discuss experiences on the water-energy-food nexus (especially in relation to infrastructure); to feed into the development of concepts and ideas, and to identify broad policy principles that allow for multi-sector and multi-purpose infrastructure development.

The purpose of the Symposium was to share and discuss experiences of the water-energy-food nexus in China and globally. Outcomes of the Symposium included the co-development with participants and lead authors of five synthesis papers. The draft papers cover the following topics:

- Synthesis Paper One: 'Cleantech' for water, energy and food solution
- Synthesis paper Two: Using the nexus to accelerate water stewardship
- Synthesis Paper Three: Influencing pathways of investments for the nexus
- Synthesis Paper Four: Natural infrastructure in the nexus
- Synthesis Paper Five: Power dynamics across the nexus

The synthesis papers highlight sectoral and integrated challenges and best practices, and identify connections between the different sectoral components of the nexus.

This report is structured as follows: Section Two provides an overview of the Nexus Dialogue on Water Infrastructure Solutions. Section Three outlines the objectives and structure of the symposium. Section Four positions the symposium in the context of China and explores the nexus resource challenges faced by the emerging economy of China. Section Five briefly introduces the global experiences in the water-energy-food nexus. Section Six presents five draft synthesis papers as the important outcomes of the symposium. Section Seven introduces the draft F.O.R.C.E framework for nexus discussions and summarises feedback from participants. Section Eight reflects on the proposed actions and recommendations for moving forward. The report concludes with the information on the next steps of the Nexus Dialogue on Water Infrastructure Solutions.

2. The Nexus Dialogue on Water Infrastructure Solutions

Since 2012, the International Union for Conservation of Nature (IUCN[4]) and the International Water Association (IWA[5]) have collaborated on a joint initiative to address competing demands on water resources across the water, energy, and food sectors, with the objective being to identify how solutions are being provided through infrastructure and other means including technologies. The 'Nexus Dialogue on Water Infrastructure Solutions' is a call to action to those leading transformations in water infrastructure planning, financing and operation. With a continued increase in water abstractions and use from growing populations, and more irregular patterns of water availability due to climate change, the pressure on water supplies is rising.

This Dialogue is an outcome of the Bonn Nexus Conference back in 2011, and the call to action that the conference requested, specifically on initiatives that could mobilise stakeholders around particular issues. At the Bonn Conference there was increased interest in investing in water infrastructure in different parts of the world because of concerns around water storage, water supply and flood protection, as well as securing water for food production and the need to better cope with increasing hydrological variability. This Dialogue has therefore focussed on infrastructure, and technology –

[4] http://www.iucn.org/

[5] http://iwahq.org

because of the increasing demand for solutions adopting technological innovation, and the interest in dams and large scale water storage and built infrastructure solutions.

The Dialogue has also deliberately focused on water, energy, and food – and has not expanded to include climate, environment, or many other suggestions the Secretariat has been advised to consider. Climate will impact on the availability, quality, and use of water resources which will affect electricity generation and supply, and will also affect land productivity for food production and ecosystem health, including carbon sequestration. The environment – and the services it provides and the impacts it absorbs from climate related changes and human induced impacts is central to the nexus – it is the underlying resource base. Under the Dialogue this has been focused on through the natural infrastructure subject. The Dialogue has deliberately not broadened the framework wider than water, energy and food to maintain focus, to allow for adequate cross-sectoral discussion but which can be appropriately managed, and to avoid the re-siloing of issues such as environment, carbon, soil, climate, etc. Sectors do not operate in these silos; they operate through public sector profiles that are loosely structured on water, energy, and food production as staples of societal needs, and economic development. The purpose of the Dialogue is to identify consensus on sustainable and resilient water management for water, food and energy security.

Increasing urbanisation and economic growth provide significant benefits, but also pose a range of challenges especially for water quantity and quality. Water, energy and food security rely on water infrastructure. Recognition of the closely bound interaction between water, energy and food (or the management of land for food, fodder, and fuel production) – the nexus – has led to new demands for water infrastructure and technology solutions.

What is the Nexus?

Water uses energy, energy uses water, agriculture needs both and modern society needs all three; and they all rely on infrastructure to manage water. In this way, land, water and energy systems are inter-connected and have become increasingly more complex and dependent on one another. As a result, disturbance and change in one system can destabilise the others. For example, recent extremes of droughts and flood have forced an evaluation of how water infrastructure impacts other sectors – highlighting the need for a 'nexus based' multi-disciplinary, cross-sectoral approach to look for 'win-win' solutions while balancing environmental, social and economic issues. As world populations continue to grow, they will need to be serviced with water, energy and food against a backdrop of climate change.

The **nexus** – a series of connections, or the focal point of connections. The Nexus Dialogue is designed to speak across sectors to allow for a two way exchange or flow of information and perspectives. Through this process joint learning can be encouraged, perspectives understood, and joint solutions identified.

To address competing water needs cities and utilities need to diversify water supply options from a single source to a portfolio of supplies. They will need to optimise water infrastructure for multiple purposes, including investing in watersheds as natural infrastructure to work in concert with built infrastructure which supplies water to cities, industry, and the agro-industrial complex of many economies. This will require cities and industries to engage effectively and efficiently in river basin management and support the equitable negotiation of sustainable water allocations across users.

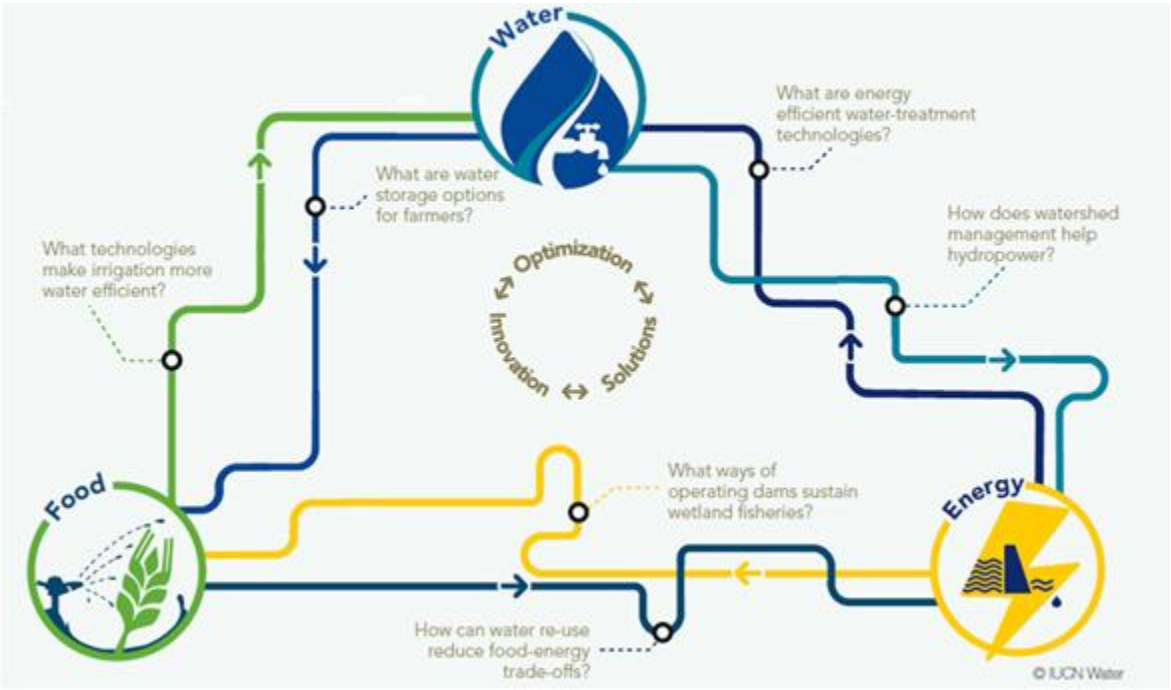


Figure 1: Interactions of water, energy and food - the nexus

The Nexus Dialogue is future-focused, examining how engineered and nature-based water infrastructure and technology are currently being used and can be made more functional and sustainable (Figure 1), to secure water, energy generation and food production while balancing environmental, social and economic issues.

More complete and, at times, broader cross-sectoral thinking is required to deal with the challenges around water, energy and food production efficiencies, trade-offs, and cross-sectoral impacts. The Dialogue provides a global platform (Figure 2) for sharing experiences, lessons, tools and guidelines on how portfolios of water infrastructure and technologies can address nexus challenges.

Figure 2: Global Dialogue Platform

Since 2012, the Dialogue has successfully organized a series of regional anchor workshops in Africa, Latin America, South-East Asia (in partnership with UNESCAP) and Central Asia (in partnership with the EastWest Institute).

Figure 3: Nexus Dialogue Anchor Workshops

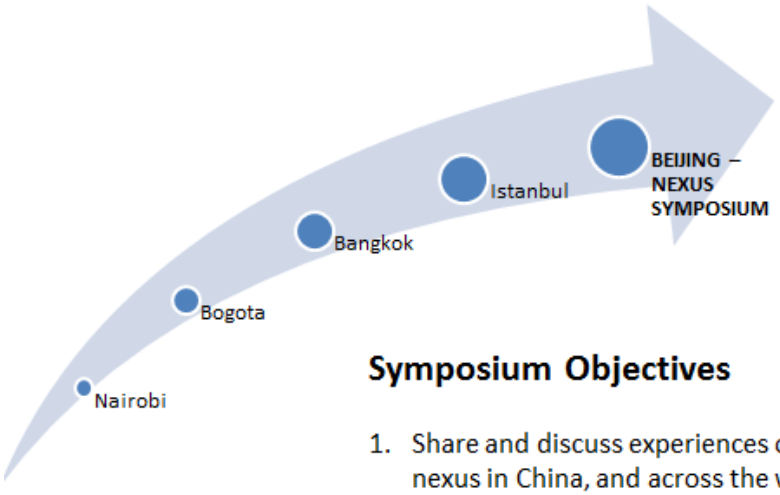
Each workshop brought together innovators and thought leaders from the water, food and energy sectors and emphasized how our interactions with the water cycle are increasing in complexity In all workshops participants from water, energy and food sectors across the various regions, countries and river basins were all asked to identify their particular nexus problems, the proposed solutions and how these can be implemented. In some cases, short proposals or 'concept papers' were jointly developed during the workshops to better identify practical solutions to problems, with activities and appropriate budgets developed. In Istanbul, efforts were focussed on better understanding 'investment grade' proposals, for funding from both public and donor partners, but also from private sector investors.

Based on learning from the workshops in Nairobi and Bogotá, identifying the 'problem' that exists in the cross-sectoral dimension, which may often only be bi-lateral and not tri-lateral between the sectors, allows the different agencies to recognise themselves as 'stakeholders' of the problem. This allows for focussed attention, and action to solve the problem. Consequently, the workshops in Bangkok and Istanbul adjusted methodology to focus on the development of actual proposals to solve jointly identified and agreed problems.

3. The Symposium Objectives and Structure

The Symposium on Infrastructure Solutions in the Water-Energy-Food Nexus invited approximately 80 international and regional professionals, from public, private and civil society organisations, to work together on identifying broad based policy recommendations that allow for multi-sector and multi-purpose infrastructure development. The Symposium provided the opportunity to present learning from the series of earlier Dialogue workshops. Participants invited included past participants from the earlier workshops, and others who had been specifically invited to join the Symposium.

Through presentations (Day 1 and Day 2), plenary discussions (Day 1 and Day 2), carousel discussions (Day 2) and group discussions (Day 3), the Symposium the collection of ideas to feed into the development of the synthesis papers, to test the draft F.O.R.C.E framework to assess the applicability of the framework and the questions within it, and to better understand how the nexus materialises, and is being addressed in China.



Symposium Objectives

1. Share and discuss experiences of the water-energy-food nexus in China, and across the world.
2. Present learning from recent nexus dialogue workshops in Africa, Latin America, Asia, Central Asia, and others.
3. Present synthesis papers which bring together sectoral and integrated best practice; identify and analyse the main drivers for joint solutions;
4. Identify broad policy principles that allow for multi-sector and multi-purpose infrastructure development.

The symposium started with an overview of the Nexus Dialogue on Water Infrastructure Solutions with information on how the dialogue has evolved over the course of the workshops in each region. In the first workshop In Africa, the focus was on discussing best practices. The solutions identified centered on technical led development and planning. The following workshop in Latin America moved towards optimizations of these best practices. There was a stronger emphasis on institutional, governance and financing issues.

In Asia, the focus was on how to mobilize and implement best practices and innovative ideas, including securing the enabling environment that can make that happen. In Central Asia, the aim was to go a step further by enhancing collaboration and identifying practical steps toward implementing water, energy and food nexus planning and practices in the Amu Darya River Basin. This included the development of a series of investment grade proposals.

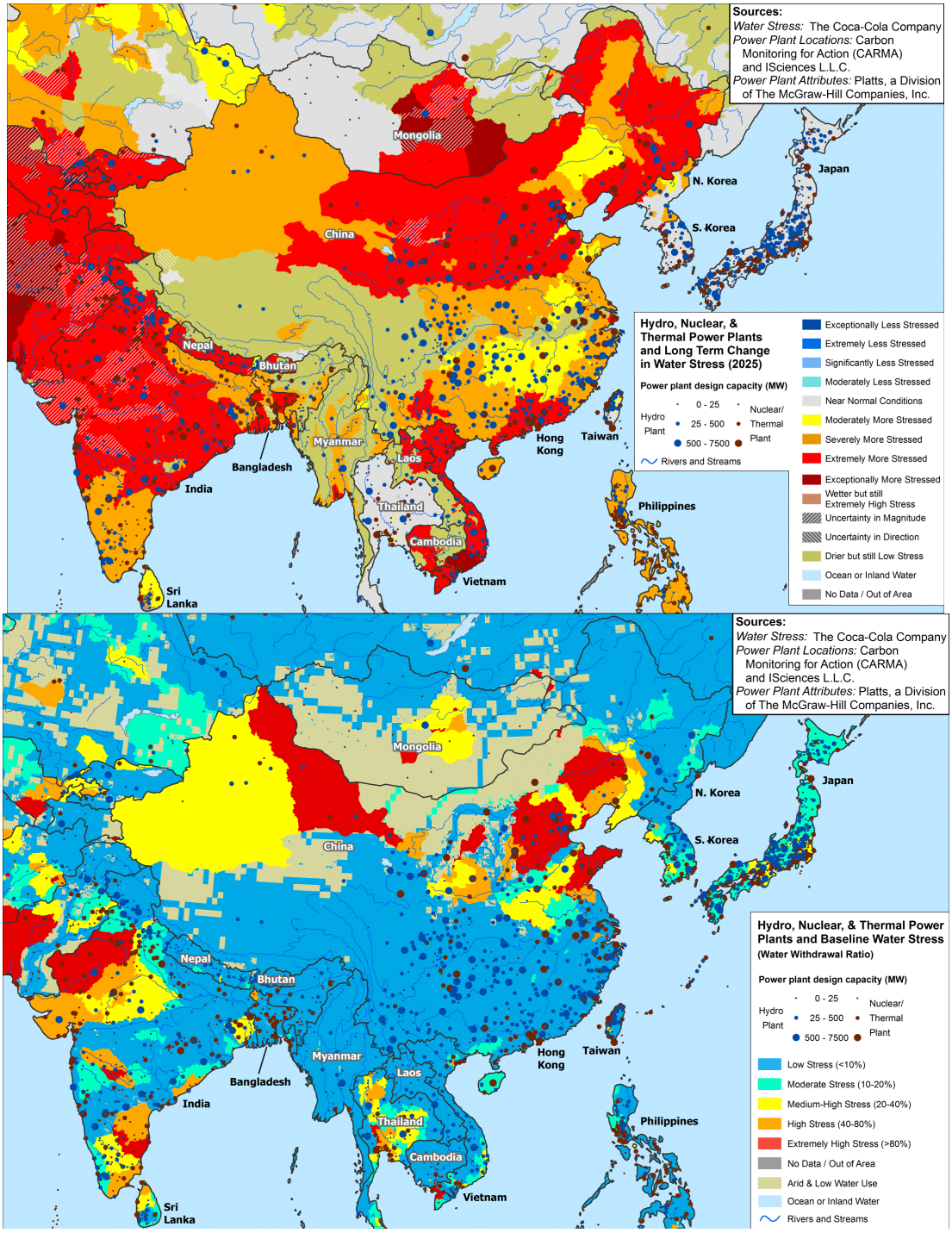
4. Overview: Nexus Resource Challenges in China

China is a huge laboratory for the nexus. The pinch points are seen in China where there is friction between water, energy and food sectors; but the friction can be a source of solutions to all the nexus challenges. –Feng Hu, China Water Risk

We would like to communicate with colleagues from other countries, share the experiences of water management, and give our efforts to ensure the water security, for the food security, ecosystem security and also energy security. – Mrs Shi Qiuchi, Ministry of Water Resources, PR. China

The first set of presentations on Day 1 focused on how China is addressing the challenges of the impacts across inter-linked water-energy-food resources. The discussion was timely as China is increasingly considering ways to address the huge resource pressures while increasing the economy, protecting the environment and improving livelihoods.

China is the most populous country in the world, with approximately 1.3 billion people (22% of the world population). In order to sustain the population and economy, there is a growing demand in water. However, water scarcity is threating many cities and regions in China. About 400 of China's 660 cities are reportedly short of water; of those, 108 cities, including megacities like Beijing and Tianjin, are facing serious water shortages. China's per capita natural freshwater resources are predicted to drop to 1,875 m^3 by 2033 from 2,156 m^3 in 2007. (World Bank, 2009)



Dr. Fang Dong, China Water Engineering Association, indicated that because of the climate and geographical complexity, water in China is unevenly distributed from North to South and from East to West. In general, the South has more water than the North and the coastal East has more water than

inland West. This characteristic in water distribution is not well-matched with the distribution of population, arable land and energy resources reserves. The Yangtze River Basin supplies water to half of national population who live in the southern China with four-fifths of total naturally available water resources. But for the other half of population and two-thirds of the country's farmland in the North, only one-fifths of water is available. The North is also rich in oil and coal reserves and is the traditional heavy industry area. The water shortage in the North leads to more fierce competition for water in different sectors.

Every year tons of water is withdrawn for agriculture and energy purposes. However, not enough water flows back to recharge the deep and superficial aquifers. Even worse, many rivers, lakes and underground water are contaminated by the discharge of industrial pollutants and chemicals like pesticide and herbicides. The fallout from climate change, the overexploitation of resources, and delays in infrastructure optimisation start to emerge. In 2014 Liaoning province in northeast China experienced its most severe drought in 63 years, affecting more than two million hectares of crops and leaving 136,000 people without water (Xinhua News).

As with many other countries and regions, China is experiencing a nexus dilemma: on the one hand, both agriculture and energy industries place a huge demand on water; one the other hand, both food production and energy generation tend to create water pollution and cause water resource overexploitation and thus worsen the water crisis. The continuing trend in population growth and accelerated urbanization and industrialization place massive pressures on natural resources. The solutions to sustainable development are closely associated with the linkages between water, energy and food. The nexus approach emphasizes that cross-sectoral communication and cooperation is essential to find solutions to the challenges in water, energy and food and to secure the social, political and economic well-being.

In China, water issues are intimately tied to its energy choices. According to the statistics of US Energy Information Administration (EIA), China is the world's top coal producer, consumer, and importer and accounted for about half of global coal consumption (EIA, 2014). Domestically, 69% of China's energy comes from coal; however, coal mining is highly water-reliant.

Deng Ping, Greenpeace China, mentioned in her presentation that it is estimated that the 16 large-scale coal power plants in China need at least 9.975 billion m^3 water to meet the goal of 2.2 billion tons of coal output in 2015. This figure in water demand is daunting, because the required amount of water is equivalent to one sixth of the total water volume of the Yellow River during a normal year. For provinces like Shan Xi, Ning Xia and Inner Mongolia, the current ratio of energy-related water use can hardly satisfy the rapidly increasing demand for coal. This means that the coal industry is likely to result in significantly increased competition of water for energy, irrigation and ecological conservation.

It is predicted that coal consumption in China is going to increase by 50% in the coming decade (EIA, 2014). Even though the domination of coal-fired thermal power in electricity production cannot be easily changed, China is making efforts to diversify its energy portfolio and encourage clean renewable energy.

"We expect water scarcity to continue driving the installation of wind and solar power in China" -- Bloomberg New Energy Finance, China Power Utilities in Hot Water, August 2012.

Dr. Liu Heng, International Center on Small Hydropower/GWP China Regional Technical Committee, suggested that hydropower is going to have a bigger role in the water-energy-food nexus in China. Compared with solar, nuclear and wind power, hydropower is the leading the position in renewable energy. The development of hydropower is a key consideration within the national strategic

plan of China[6]. Currently hydropower generation in China accounts for 280 GW, which already exceeds the goal of 260 GW (by 2015) indicated in the 12th National Five Year Plan. However, the per capita hydropower generation in China is only 0.75 KW, much lower than USA (3KW) and Japan/Europe (1.5KW). Hydropower is expected to receive continued support from the Chinese government in the near future to achieve per capita targets.

GLOBAL EXPERIENCE

The increase in hydropower production on transboundary rivers indicates the need to address geopolitical risks by multilateral and bilateral dialogues between China and its neighbouring countries. **Prof. Patricia Wouters, China International Water Law Programme, Xiamen Law School**, suggested the necessity of using a legal framework which emphasises the role of law, encourages dialogues and catalyses win-win solutions to help tackle the legal and geopolitical challenges in the nexus.

Economic	Environmental	Other
• APEC • Free trade agreements (FTAs) • Energy agreements (Sino-Russian)	• MEAs – UN Conventions (Biodiversity; Climate Change; Ramsar; Desertification) • Global instruments (UNWC; UNECE TWC) • Bilateral agreements – i.e. transboundary water resources	• Development (South-South cooperation) • Human rights • Declarations / soft law

Small hydropower is a potentially abundant resource in China. It could be widely distributed over more than 1700 counties across 30 provinces, mainly in the western part of China. It has a total potential capacity of 128 GW. Small hydropower can not only meet the needs of basic electricity supply and rural communities, it can also be used for pumping and irrigation to support agricultural production, and food security. Therefore, small hydropower will have a key role in the water-energy-food nexus.

[6] The 12th Five-year Plan was debated in mid-October 2010 at the fifth plenary session of the 17th Central Committee of the Communist Party of China (CPC). A full proposal for the plan was released following the plenum and approved by the National People's Congress on March 14, 2011, with the goals of addressing rising inequality and creating an environment for more sustainable growth by prioritizing more equitable wealth distribution, increased domestic consumption, and improved social infrastructure and social safety nets. Click here for the full 12th Five-year Plan Report (English version).

Food security goes hand in hand with water security**. Dr. Cai Dianxiong, Chinese Academy of Agriculture Sciences/ GWP China Regional Technical Committee**, argued that for China the key issue was whether it could do to effectively improve its water use efficiency and diversify water sources for crop cultivation. Currently, water use efficiency rate in north-west China is only 30%. In southern China where there is more rainfall, the rate is even lower. Soil water (green water) from natural rainfall will play an important role to keep crop yields stable in coming years in China. Approaches to increase the water holding capacity of soil and capture rainwater will be important to alleviate the water stress in food production.

Xiechen, China National Forestry Economics and Development Research Center, State Forestry Administration, used the example of the Conversion of Cropland to Forests Program (CCFP) to illustrate how food security is closely linked with water security. CCFP started in 1998 when China was hit by severe floods, partly exacerbated by deforestation. In response, China launched this program to control floods and reduce soil erosion.

Although CCFP initially focused on water management, within the 16-years' development, CCFP's intrinsic connections with food and energy have been identified and strengthened. An integrated irrigation system that safeguards both crop land and rural energy is one of the pillars of the program. To benefit agricultural activities, the conversion from slope land to terraced land is also encouraged. Cropland infrastructure is strengthened to ensure food security of CCFP farmers. To benefit energy generation, rural energy practice such as fuel wood plantation, biogas, etc. has been promoted. Small hydropower and solar energy play a bigger role than before in supporting the CCEP project. CCEP has set up a national-wide monitoring system that enables monitor sites to collect relevant data from 24 provinces, 125 counties, 233 villages and 3000 rural households. This system can lower the costs and risks in decision-making around the trade-offs between water-energy-food by improving the accessibility of data.

5. Overview: Global Experiences on the Water-Energy-Food Nexus

Water-energy and food security issues have traditionally been tackled in isolation within national and sectorial boundaries. They have been thought of as separate systems but recognising the linkage between them is an opportunity to find sustainable solutions in an integrated way to preserve natural resources. – Dr. Munira Aminova, Vrije Universiteit Brussels

The second set of presentations on Day 1 were from a variety of experiences across the world. Sharing these best practices and good experiences from a variety of perspectives can inform nexus management in different countries that are facing similar problems.

Paul Wyrwoll, FE2W Network/Australian National University, highlighted the following three significant aspects in maintaining the inter-linkages across the water-energy-food nexus:

- Understand risks to the security of food, energy, environment and water;

- Engage decision-makers on developing and implementing scalable, integrated resilience frameworks

- Enable action at all scales that results in in sustainable long-term outcomes

Paul Wrywoll advised of the necessity for providing decision-makers with the knowledge and frameworks to balance nexus trade-offs. He also posed the question "Which policy instruments are flexible and durable enough to efficiently balance dynamic nexus trade-offs?" In other words, what polices can be put in place so that access to one resource does not divert others. The FE^2W Network (www.fe2wnetwork.org) aims to address this question through: understanding risks to nexus security; engaging decision makers on developing and implementing scalable, integrated resilience frameworks; and enabling action at all scales that results in sustainable long-term outcomes.

A similar point was raised in the presentation by **Bassel Daher, Texas A&M University, USA**. He and his team have been working on identifying and quantifying inter-linkages between water, energy and food by using the Resource Management Strategy Guiding Tool (wefnexustool.org) for trade-off analysis. The tool allows for determining policy preferences through weighing different resource outputs in different scenarios in order to reflect possible strategies. They also took into account the diversified demands and characteristics in different industries, practices and regions, trying to come up with holistic localized assessments in water-energy-food nexus. This includes being able to identify and quantify possible trade-offs among interconnected systems and understand what is the threshold for sustainability.

GLOBAL EXPERIENCE

Hydropower is renewable but not always sustainable. -----Dr. Eric Baran, World Fish Cambodia

Fish contains more animal protein than cattle which is significant to food security. However, the fish industry is facing threats from built infrastructure in the river systems.

Dams play a role in sediment retention and lead to the effect of water clarification. Water with sediment sustains the Mekong River Basin food chain. Clearer waters will reduce fish. Many more dams are planned along the main Mekong river. These built infrastructures are expected to block fish migrations and trap sediments originating from up-stream China.

Hydropower is renewable but not always sustainable. A more comprehensive planning system is required to ensure food security in the Mekong River Basin while also providing for energy-water needs across the nexus. Some recommendations include:

- Maintain some rivers intact. This actually has been achieved in Vietnam: some areas are set for dam development, while some other rivers are free flowing to ensure fish migration and productivity.
- Plan dam development strategically, and promote energy production that has a lower impact on biomass and biodiversity
- Rethink dam design, e.g. Consider sediment passage options at dam sites and design that allows fish migration.

Focusing on multi-purpose hydropower reservoirs, **Emmanuel Branche, EDF**, introduced the EDF-WWC (World Water Council) Framework which was designed to minimize contradictions/competitions among multipurpose water uses of hydropower reservoirs; to set an appropriate governance framework to allow coordinated/ integrated water uses management (in terms of strategy, planning, decision-making and operation; and to address the financing and economic issues of developing and operating the multipurpose hydropower reservoirs.

Reservoirs adjacent to dams are not only used to generate hydropower, but also meet other needs, like flood control, water storage, irrigation, fishing and recreation. Realising the importance of involving multiple users, EDF presented the case of Durance-Verdon, where EDF gave compensation to irrigators for water savings. As a result, agricultural water consumption decreased from 310 Mm^3 in 1997 to 201 Mm^3 in 2006; and the water saved from agriculture was used by EDF to improve performance in energy generation, environmental protection and tourism. The case demonstrated that it is essential to work collectively with stakeholders in a river basin to find win-win solutions and minimize negative impacts.

The US has a wide diversity of experiences in dealing with the nexus. **Jordan Macknick, US National Renewable Energy Laboratory**, pointed out that actors from different sectors need incentives to work together for mutual benefits. One example, demonstrating this was Xcel Energy, a utility holding company based in Minneapolis, Minnesota. The electric utility with hydropower and thermal generators requires reliable water resources in a drought-prone area where agriculture dominates water use. Xcel Energy decided to partner with the local agriculture community to buy water recharge credits and to purchase excess agricultural water for energy operations when needed.

The success of Xcel reveals the importance of assessing trade-offs and developing arrangements that address the core needs of each party in the nexus. Xcel's strategy does not only benefit the energy company that required reliable water for power generation. It equally benefits agriculture that has a stake in reliable power for pumping.

Jordan Macknick also pointed out that case studies provide a unique opportunity to help inform policies. However, policy itself is not enough. It also needs to be committed on the ground actors. Sometimes crisis such as floods, droughts can externally catalyse joint actions, but to gain continuous and stable momentum for cross-sectoral cooperation needs effective leadership and long term commitment.

This point was supported by **Helen Bellfield, Global Canopy Programme, Oxford UK** focusing on the Amazon. More frequent extreme events like floods and droughts served as a warning of water vulnerability, which was once unthinkable in this resource-abundant Amazon region. Stakeholders started to realize that shared ownership of Amazonia's resources also means shared risks and they should work together to pursue the long-term security and prosperity that will in turn benefit all of them. A ministerial panel from 5 governments has engaged and supported the Amazonia Security Agenda

which aims to address risks to water, energy and food security. This project is attracting more actors across sectors in Amazonia region to cooperate around water management to strengthen water use across the nexus security.

As with the Amazon, the regional collaboration between the countries that share common water resources is also significant for Central Asia. **Dr. Munira Aminova, Vrije Universiteit Brussels perspectives in Central Asia** presented on the use of nexus thinking as a mechanism for peace and stability in Central Asia. This region has experienced massive geopolitical, economic and social changes since the disintegration of the Soviet Union. Policy-makers are inclined to give the first priority to how to avoid having conflicts and losing power. Water polices are thus regarded as less important. However, water is a key issue as many conflicts in the region were initiated by water scarcity, and the subsequent energy stress and food shortage. Dr. Munira Aminova also highlighted the concept of nexus governance in the management of resources in Central Asia. This framework emphasized cooperation across sectors (water, energy and food) and countries, long-term vision of decision-making and three domains of governance, which are public sector, private sector and civil society.

Conclusions of Day 1

Mark Smith, IUCN, provided some overall insights and concluding remarks from the presentations and discussion of the first day. The presentations from Day 1 explored the challenges we are facing and examined how we can move forward in the idea of nexus. Water is the major barrier to food production and energy generation in many countries. We learnt that positive changes have been happening in China. Many large coal mines are located in the water-stressed cities. Hydraulic power was expected to diversify the current energy portfolio dominated by coal. Hydropower infrastructures, both large and small, have been strongly encouraged by the government. Agriculture is the biggest water-consumer in China. There is an increasing awareness to improve the irrigation efficiency and to free up water for other uses, such as for energy and ecosystems.

There is a call for coordination among different sectors and agencies in order to find options to reduce the pressure on various pinch points. For example, improving irrigation efficiency can mean water is available for other uses. Case studies and experiences from the globe helped identify what the coordination mechanisms could be and how to make them effective. We learned from many examples that collaboration often started from very concrete and specific points in one sector. For example, forest restoration schemes address soil erosion but solving that problem brought together different actors and extended solutions to other areas. Specific challenges opened spaces to solve the original problem and address other sector issues.

Gaining continuous and stable momentum for cross-sectoral cooperation needs long-term commitment and adaptive and flexible policies. Decision-makers are pushed to think about how to effectively balance nexus trade-offs and how to manage resources in a way that does not compromise each other's interests. Data and assessment tools on how each sector works can contribute to a wide variety of options to find solutions and wise decision-making. To understand, build and use the legal connectivity would help find a way through transboundary nexus issues.

The key message from Day 1 was that we need to identify pinch points and focus on real problems that each sector wants to solve. There should be more spaces for benefit sharing and more room for different voices. Only in this way we can get stakeholders from different sectors committed and motivated to work together on the ground.

6. Overview of the Synthesis Papers

The aim of the synthesis papers is to bring together integrated best practice, and to make insightful connections between the sectoral components of the nexus. The five synthesis papers identified key

factors for an appropriate enabling environment that could allow cross-sectoral opportunities to work better and at the most appropriate scale. Trends and strategic entry points for access into the water-energy-food nexus were elaborated. Also, the synthesis papers gave attention to the challenges within each theme, and started to identify incentives for improving the existing technological financial and institutional arrangement to better respond to the water-energy-food nexus.

The five themes were developed based on learning from the Nexus Dialogue to date. The synthesis papers examined connections across the water-energy-food nexus that could be formed into a practical example of synergies, opportunities, and challenges on each particular theme, and were supported and substantiated by rich examples of case studies and references. The Papers are targeted for a broad audience – from investors, policy advisers, regulators and practitioners. Papers will be designed to be relevant to each other, but also valid as stand-alone documents.

- Synthesis paper 1 : Cleantech for water, energy and food infrastructure solutions
- Synthesis paper 2: Using the nexus to accelerate social development and support water stewardship and corporate engagement
- Synthesis paper 3 : Influencing pathways of investments in the nexus
- Synthesis paper 4 : Natural infrastructure/ecosystems in the nexus
- Synthesis paper 5: Power dynamics (policy and institutional change/collaboration) across the nexus

By providing an evidence foundation for identifying solutions to the nexus challenge, the synthesis papers were also used to guide dialogues and discussions during the symposium. At the beginning of Day 2, each lead author briefly presented their paper. This was followed by carousel discussions where participants of each group stayed at a designated table and the paper authors moved around the tables to discuss the presentation and findings with participants at each station. All five groups were given the same time to talk to the authors. Authors at each table and facilitators captured discussion on flipcharts, and a series of questions were posed to stimulate and guide discussion:

1. What are the strategic entry points (opportunities) for the theme to create connections between water-energy-food?
2. What is the applicability of the theme to different context and scales?
3. What policies, regulations, legal framework and incentives (enabling conditions) does this theme need for cross-sectoral opportunities?
4. What additional cases, best practices and recommendations do you have?

The following are the summaries extracted from the five synthesis papers. For more details such as feedback and comments of participants on each synthesis paper during the carousel discussion, please refer to Appendix Three.

Synthesis Paper 1: Cleantech for water, energy and food infrastructure solutions

The interconnections between water food and energy are generally well-understood – saving water saves energy, and vice versa - although the level of interconnection may be surprising to many. However conservation of water and conservation of energy have an important difference: water is a resource which is endlessly recycled and losses are often available for reuse (although there can be problems with quality, timing or location). By contrast, most energy is – still - from fossil fuels and the losses are ultimately truly lost, despite the scope to minimise the losses and to make use of 'waste' heat. The relatively poor control of these traditional uses means that water is not used as productively as it might be, for instance flood irrigation loses water to evaporation which can be avoided by precisely controlled drip irrigation technology.

Good control and management therefore saves energy, increases production, and enables diversification of uses. However, it is important to consider who benefits from this – many agricultural water users are poor and have few resources to improve their water management or to optimise their use of the water. There is a need for improved high-level management of water resources (water rights and water allocation) combined with better local management. User organisations can have an important role to play, but their limitations must also be recognised. Multiple livelihoods and extensive seasonal and long-term migration both restrict their potential. Maximising productivity of water for agriculture will require land consolidation and commercialisation of farming, but this must be done in a way that does not compromise the interests of the majority of the rural poor.

The main current applications for cleantech are in the urban and industrial sectors, as most water use is for smallholder agriculture, for which cleantech is most difficult to apply. Addressing the nexus for smallholder agriculture depends partly on the large-scale application of many relatively simple innovations and institutional changes, but there is also a strong need for cleantech innovations. These can have powerful impacts – large-scale drip irrigation is becoming more practical and affordable, partly due to increasing demand for fruit and vegetables from the growing urban middle classes. Safer techniques for reuse of water for peri-urban agriculture have benefits for energy saving, water and food security. The very large numbers of farmers mean that the market for innovations is very large. Cleantech in non-agricultural is much further advanced than for agriculture - especially for small farmers.

Key recommendations therefore include:

- Development of cleantech for smallholder agriculture in low income countries – affordable

- Technology for monitoring water use as well as soil moisture conditions-using rainfall better
- Forecasting and risk analysis and hence development of appropriate agricultural insurance
- Peri-urban agriculture – treatment for water reuse to be safe for vegetable and fruit cultivation
- Better integration of smallholders into supply chain for agribusiness, to enable better access to cleantech.
- Tools for water and energy audits.
- Addressing institutional and financial constraints to adoption of established technology

Synthesis Paper 2:

Using the nexus to accelerate social development and support water stewardship and corporate engagement

Both the concepts of 'Nexus' and 'Stewardship' have evolved somewhat in parallel over the last few years. Their interconnection is perhaps not fully understood and recognised by academics and policy-makers, especially since both of these concepts have largely emerged from, and until recently, have been predominantly driven by the private sector. The paper lays out the both the private sector connection to the nexus and how the role of stewardship is driving greater private sector involvement in resource policy decision-making. Academic debate around water, food and energy interconnections are not necessarily new. Equally, private sector involvement in water policy or water management decision-making has been a reality in many parts of the world. What is different today is the scale of the upsurge in interest in both Nexus and Stewardship debates and also the reasons behind them.

For businesses, the idea of engaging in water stewardship requires a conceptual shift - to see themselves not simply as users of water as a natural resource but, along with other water users, collectively responsible for its wise management, appreciating the wide range of ecosystem services that it provides for them and others. In a more business-minded sense, water stewardship can be considered as a response to the growing legal, financial and political duty of care obligations faced by water users to ensure the sustainable use and equitable management of water both within and beyond the 'fence line' of their operations (Hepworth and Orr, 2012). Water stewardship implies a progression of increased water use efficiency and a reduction in the water related impacts of internal and supply chain operations. More important still is the commitment to the sustainable management of shared water resources through collaboration with other businesses, governments, NGOs and communities (WWF, 2013).

Business connection to the nexus – at its most basic - is through the delivery, production or supply of energy, food or water, and through the interconnection and reliance on any one of these in inputs to their own business model. As basins become crowded, as populations grow, and as climate change takes effect, more solution providers will be required, and increasingly this will involve many delivering for broad public service agendas. As stewardship evolves, a new era of more hybrid institutions and corporate players providing benefits beyond their fence-lines will grow. Yet, stewardship is in its infancy. Unless risk becomes real and society and government regulate and hold companies to account, the incentives to act will remain low. The room for companies to hedge their supply chains and shift their markets (because of risk) depends on the sector and how it engages resource use, as well as how the sector itself operates in policy and advocacy.

Synthesis Paper 3: Influencing pathways of investments for the nexus

Water, energy and food interactions (the Nexus) are closely bound. It is therefore essential to recognize that those isolated investments aimed at just one of the component sectors are not fit for purpose. The key question looking forward is how to channel investment flows across river basins in order to prioritize integrated Nexus initiatives that seek to reduce potential for resource conflicts, improve environmental protection and increase the longer term prospects for economic development

and sustained impact. Recognition that the ultimate goal of infrastructure investments is the delivery of value adding services to both individuals and communities is a critical first step. This paper discusses the potential for service-centric business models that maximize system synergies and optimize system efficiencies, to transform the value delivered across the entire Nexus ecosystem.

Evidence show that strategies and business models tailored to the regulations and laws of mature markets do not translate well into the markets of emerging countries, many of which are characterized by opaque regulatory climates, weak institutions, and invisible influence networks that may expose companies to unacceptable legal and reputational risks (Buchanan and Clayton, 2014). Water, food and energy ecosystem actors have not yet agreed that cross-sector collaborations make sense and align to their needs. Nexus projects are struggling to attract private sector investments and promote pubic private partnerships (PPP) in the absence of clearly defined markets. Besides the lack of updated understandings of the status of the complex nexus ecosystem, limited resources to evolve capability and capacity is put technical obstacles before cross-sector collaboration. Nexus advocates must consider how to translate hypothetical project benefits into tangible services that meet individual stakeholder requirements.

To tackle the challenges that restrict both the current investment strategy and the potential opportunities that can be realized with the development of a data driven approach that supports financial innovation and leads to sustainable Nexus solutions, some recommendations that highlight the considerations and capabilities required to drive successful Nexus investments in the future include. 1. Shifting emphasis to the needs of water and energy consumers and service providers. By articulating the goals and understanding motivations of key stakeholders, it is possible to stimulate discussion of their respective value propositions leading to development of sustainable business models. 2. Making the case for private sector investments. Commercially viable Nexus projects will have a greater chance for long-term impact and sustainability. 3. Developing collaborative data platforms that facilitate transparency, discovery, and interconnectivity, and cater to the service needs and desired cognitive experiences of the water ecosystem.

Synthesis Paper 4: Natural infrastructure in the nexus

This paper provides an overview of how natural infrastructure effectively addresses interconnected challenges facing water, energy, and food systems. By presenting the most recent developments and studies regarding natural infrastructure alongside examples of ongoing efforts, it outlines strategies to scale up the use of natural infrastructure in order to improve integrated management of water, energy, and food systems now and into the future.

Nature can substitute, safeguard, or complement built infrastructure projects in ways that are proven to be effective and cost-competitive with business as usual. Natural infrastructure, such as forests, floodplains and riparian areas, can provide many of the same services as built infrastructure, including the ability to filter water, minimize sedimentation, and reduce the impact of floods, along with additional benefits, such as the ability to sequester carbon and even provide food.

The opportunity is ripe to more effectively utilize natural infrastructure, but strategies are needed to cultivate leaders across all sectors to champion the effort to scale up natural infrastructure. Industry,

communities, governments, financial institutions, international development organizations, and conservation groups should devise new partnerships that 1. Routinely assess the feasibility, as well as the economic and social benefits and trade-offs, of natural infrastructure, 2. Communicate the results of assessments and identify barriers to implementing natural infrastructure, and 3. Scale up the role of natural infrastructure in the water, energy, and food nexus based on lessons learned from successful demonstration projects.

Synthesis Paper 5: Power dynamics across the nexus

Differences between water, energy and food must be taken into account when considering each other's limits, synergies and entwined predicaments. Energy can be produced from many sources and in different locales: water cannot be manufactured and one has to live within its limits. Energy – especially non-renewable – can be mined and the institutional requirements for it can be handled as a security issue: just send in your army, secure the site and mine away (or "drill baby, drill"). Water (and food) needs to be primarily harvested and it is only at their specialized ends that they need specialized processing.

It is argued in this paper that, if we are to achieve a more nexus-like approach of trade-offs between water, energy and food sectors, if we are to see a move from unstable monistic or even dualistic governance therein to one where varied voices of different social solidarities with differing perceptions of risk and technology choices co-exist, different definitions of 'what the problem is' must find a way to the policy table and must be responded to by other voices.

The opposite of a more holistic or interdisciplinary water-energy-food nexus approach is silo-fication which is the natural consequence of hierarchic organizing and specializing at levels of social organization above the primary one of the farming family. An illustrative example of Nepal's only reservoir project is cited as a 'good' example of bad silo-fiction. This contention is that, given the lack of success of previous efforts at 'integrated management', there is a need to ask how the policy terrain can be pluralized and space provided to plural voices. Nexus thinking can be forwarded either by fortuitous enlightened statesmanship or disasters, both of which can be taken advantage of if they arise but neither of which can be planned for. Alternatively, in normal mundane times, one should strive to break silo-thinking by letting plural voices be both heard and responded to.

Key Discussion Points

- The role of partnerships between private sector and public sector (Private Public Partnership).
- Adaptive and inclusive policies that incorporate diversified voices and consider interests of different sectors.
- Identify incentives for cross-sector collaboration, e.g. benefit sharing, non-coercive mechanisms, sharing the risk to share the benefits.
- Monitoring systems to trace water /energy footprints and provide data for financing and investments
- Assessment tools for trade-off analysis in technologies and specific nexus projects.
- Tailor the solutions to meet demands coming from different industries and regions.
- Identify and quantify the inter-linkages between water, energy and food and look at specific hotspots as the entry point
- Long-term vision in nexus project planning (what are the risks, benefits and funding sources etc.)

7. F.O.R.C.E Framework and Feedback

The presentations from synthesis paper authors and carousel discussions on Day 2 provided an evidence foundation for identifying solutions to the nexus challenges. Five topics which mirrored the five themes of the synthesis papers were selected to guide the group discussion on Day 3.

The five topics were 1.Technologies, 2.Corporate engagement, 3.Influencing pathways of investments, 4.Natural infrastructure/ecosystems, and 5.Power dynamics (policy and institutional change/collaboration). Participants were free to choose their own group based on their interest in each topic. The **F.O.R.C.E framework (Framing, Opportunity, Robustness, Convergence, Effectiveness)** was introduced to guide dialogues in each group.

The nexus is a place where there is as much agreement as there is disagreement. F.O.R.C.E was designed to engage different sectors in open dialogues to promote "buy-in" for collaborative advantage and joint solutions to nexus security, as well as reduce opposing factors in decision-making processes.

The framework is deliberately broad based to ensure that it is acceptable for cross-discussion and sectoral coordination, such as the scale of nexus projects, the capacity/knowledge of the different parties involved, the technical and economic viability, and the extent of acceptability of policies. This can limit the intuitiveness of the approach, but also avoids re-siloing sectoral or disciplinary perspectives.

Participants were asked to use the FORCE framework to identify concrete nexus challenges and to collectively discuss the role of and benefits from inter-sectoral collaboration, incentives for policy coherence, roles of actors and institutions and joint visioning & planning. The table below outlines the components of the framework in more detail. Participants self-selected their groups based on their interest in the themes of the symposium. The framework was provided with guiding questions under each of the F.O.R.C.E. categories to help facilitate discussion.

F.O.R.C.E FRAMEWORK
Framing What is the problem to be addressed? What is the context and scale of the problem? Who are the stakeholders?
Opportunity: What is the opportunity for joint action and how can this be encouraged?
Robustness: What is the capacity of the regulatory/incentive framework(s) to effectively control the different uses of the resource base (i.e. water and land resources, and any impacts on them)
Convergence: Is there any coordination (within the sector – and between sectors) in prioritizing what is required? Is there collaboration between different sectoral objectives?
Effectiveness What is the effectiveness of a multi-sector approach? e.g. immediate benefits and knock-on 'domino' effects (positive and negative)

Group One— Technologies (Cleantech)

Group One applied the F.O.R.C.E framework to examine clean technology (Cleantech) in the nexus. Participants of Group one suggested that technologies which can address multiple uses provide extra advantages which not only target single problems in one particular sector, but also benefit the trade-off analysis and the optimization of resource allocations across sectors, such as hotspots for developing cleantech included wastewater treatment, hydropower, natural infrastructure, closed loop technologies, and environmental engineering – mobilising rapidly growing areas as providers of nexus solutions.

Group Two— Corporate engagement

Group Two focused on corporate engagement. Participants identified that there is a growing trend emerging to include private sector water management. More companies are in partnership with NGOs and governments to provide technological and financial supports to address the nexus risks. Better-functioning monitoring and assessment strategies are required to encourage but at the same regulate company activities. Participants also worked together to explore opportunities for collaborating across the (water-food-energy) sectors by improving efficiency of private sector supply chains.

Group Three— Influencing pathways of investments

Group Three gave attention to investment pathways in the nexus. Participants of this group examined money flows channelled into infrastructure and technology especially in emerging economies, and the factors influencing the pathway of these investments to resource water-energy-food nexus solutions.

Group Four— Natural infrastructure/ecosystems

Group Four focused on natural infrastructure. The engineered approach may not recognise inter-linkages, whereas the scope of natural infrastructure requires involvement across sectors. Group Four identified the need to promote better understanding of the importance of healthy ecosystems in well-functioning infrastructure built for irrigation, hydropower or municipal water supply, and in achieving the economic returns necessary to justify investments. Participants discussed how to optimize options assessments which include quantitative and qualitative approaches to evaluate different possible combinations of solutions considering the difficulties in cost-benefits analysis of natural infrastructure.

Group Five— Power dynamics (policy and institutional change/collaboration)

Group Five explored power dynamics in the nexus. This group gave special attentions to current and future policies for sustainable water infrastructure operation, management and optimization in the nexus, with the expectation of moving cross-sectoral discussions to implementation mode, focusing on improving the enabling environment to ensure that collaboration and joint solutions lead to shared benefits. Participants checked the factors that could integrate and deliver multiple sector benefits in the process of looking for nexus solutions, like institutional design, public opinions, international legal framework.

For more detailed feedback and comments from participants of each group, please refer to Appendix Four.

8. Actions Proposed and Recommendations

The nexus is a strong communication tool. By highlighting the interdependencies across the water, energy, and food domains sectoral dialogue becomes cross-sectoral. The key is to identify joint opportunities through identifying and negotiating any trade-offs. There is a rich array of existing practical knowledge and technologies across professional fields that can be shared and applied cross-sectorally, including farming, energy-production, natural resource management, and engineering.

The nexus is not a one-way discussion. Rather, it challenges beliefs within the tribal nature of disciplinary silos. It challenges the applicaiton of knowledge, and it highlights the need for greater integration on core elements such as data collection, sharing, and interpretation. . Through dialogue opportunities can be created to bring together people with a variety of experiences from across sectors, to brainstorm, and exchange knowledge, with the ultimate aim being to move to practical actions.

'To achieve action in the water, energy, food nexus I ask three questions. Is it technical feasible, is it economically viable, and is it politically acceptable'--Gary Lawrence, Chief Sustainability Officer, AECOM.

The nexus is also solution-oriented. It appears that water shortages, through climate variability, over-use, pollution, or a combination of these creates pinch-points in water resource availability, or challenges over allocation and use between and within sectors. Forming partnerships to solve these problems appears, across all the workshops, to be key. However, practically, there is no need to always have complete integration between sectors. Relevant stakeholders may come together to identify and solve a problem (problem holders), and then continue to implement the agreed solution(s) as separate entities.

Where there is confidence in solving the problem, the links between sectors (the nexus in practice) provides a natural, non-pecuniary incentive – joint problem identification, joint risk sharing, leading to collective action. Where there is a biophysical problem, or new regulation in the pipeline, or

competition for resources, coercive incentives may be developed – as either a financial cost, or a remunerative incentive or opportunity as a policy response. The incentive for action in the water, energy, food nexus is in identifying solutions and opportunities, using first mover advantage to solve problems, irrelevant of the sectoral actors. In some cases, civil society and the social impact sectors fulfil important roles in solving problems in the absence of public sector resources, institutional inertia, and capacity. In other cases, the public sector is forced to deal with legacy issues that affect the use of water resources, such as pollution, that affect the ability of society to maximise the economic use of the water resources, or actually deal with the pollution problem.

Gaining continuous and stable momentum for cross-sectoral cooperation needs long-term commitment and adaptive and practical policies. To manage resources in way that does not compromise interests in each sector, but promote benefit sharing is key. The nexus calls for coordination mechanisms. However, moving from a silo approach to a systems understanding requires time and space to reflect on the impacts of actions of one sector on another. Different sectors have their own strengths and advantages. Using these unique strengths more effectively is a significant step to build a systemic response to the challenges ahead.

There are many ways to not agree about the nexus. What becomes clear is that there is competitive advantage for all institutions, public, private, etc., to better understand the cause and effect relationships they are involved in through both implementation of their mandates, and policy actions and reform. Through better identification of risks, sharing the risks, and optimising the trade-offs that need to be made between sectors, advantages for different sectors can emerge.

Practical actions required based on recommendations from participants include:

- The demand for the Secretariat to define the nexus as experienced through the many varied discussions over the period of the Dialogue
- The need to prepare 'reader profiles' for the synthesis paper, and those that currently deal with, or will have to be more aware of the nexus going forward
- The need to develop key messages to different audiences, including policy makers and opinionates, the research community, practitioners, investors, and development partners, using a common thread of language that is transferable and understandable between the different audiences
- To use the interest in contributing to and commenting on the Synthesis Papers from the Beijing participants
- The need to connect hydrology to economy more clearly – to ensure the water community of practice remains water collaborative and not water centric.

9. Next Steps in the Dialogue

The Secretariat are tasked with working with authors to finalise the synthesis papers, including reviewing other material collected through the Dialogue to finalise the Secretariat's own synthesis paper. Identifying the practical case studies and lessons than can be applied, including the reference projects that should be showcased going forward.

We will also be scheduling further interactions with our Reference Group, reviewing the website and material on it, developing the FORCE framework further, and developing a roadmap for the Dialogue going forward.

The Dialogue will hold a final event at the 7th World Water forum in Daegu and Gyeongbuk, South Korea, 12-17 April, 2015. We currently have four opportunities which are being further developed at the Forum:

1. Water and Energy: economic incentives, policy and regulations (Water and Energy theme 2.2)

This session will explore how institutional arrangements and a process of collaboration can develop joint solutions leading to shared benefits across the water, energy, food sectors. This session aims to consolidate investments, address key challenges, learn lessons on new processes and technologies, and then apply them in future contexts. Experiences and examples of reconciling different water uses from the local to trans-boundary level and a roadmap of transforming dialogue to implemented solutions will be shared as outputs.

2. Special session on Water, Energy and Food with FAO.

This session is a joint proposal by the Thematic Design Group of 2.1Water for Food and 2.2 Water for Energy as encouraged by the World Water Forum Secretariat. This session will focus on what concrete steps can be taken within sectors (e.g. resource use efficiency) and across sectors (e.g. cross-sectoral policy targets) to ensure that decision-making processes will be better coordinated and more coherent. At present this session may include a Ministerial level discussion followed by a second half technical level discussion.

3. Side Event: Learning from the Global Nexus Dialogue on Infrastructure Solutions

This session is a joint proposal by IUCN, IWA, and the State Department to launch the Synthesis Papers and to invite comments and debates between paper authors and the audience.

4. Side Event: From Assessment to Action: The Nexus in Development Priorities and Programmes

The water-energy-food nexus has become a dominant narrative in water and development discussions since the Bonn conference in 2011. This session will present findings from initial nexus assessment work from across the globe, including from the energy sector, to better identify synergies for rapid development priorities. The session will be a discussion among different development practitioners, donors and investors to both challenge the rhetoric on the nexus, and identify actionable solutions currently in practice, and those that can go to scale. The session is currently under designed and we hope to include the European Commission, the GEF Secretariat, the World Energy Council, and the Infrastructure Consortium for Africa in the side event.

Other activities include finalising activities with GIZ in Latin America, mobilising activities with the Infrastructure Consortium for Africa, and supporting and promoting active discussion and sharing lessons with other relevant networks as possible, including feeding back key information to participants from earlier workshops and events. Working with participants and development partners to mobilise some of the draft concepts designed in Bangkok (with UNESCAP) and Istanbul (with the EastWest Institute) will also be a key activity over the next six months.

Appendices

Appendix One: Symposium Agenda

Day 1, Thursday 13 November 2014, ***Framing the Nexus***

Time	Session	Summary
08.30-09.00	**Arrival and registration**	
09.00 - 09.20	**Session 1.0: Opening Session**	• **Welcoming Address:** ➢ Dr Mark Smith, Director, IUCN Global Water Programme, Switzerland ➢ Mr. Zheng Rugang, Secretary General of GWP China ➢ Tao Li, China Director, IWA
09:20 - 09:50	**Session 1.1: The Nexus Dialogue on Water Infrastructure Solutions**	***IUCN and IWA:*** • Brief Participant self-introductions • Explanation of the agenda and overview of the Symposium – why are we here? • Brief presentation about the global Dialogue. This will include a 5 minute video
09:50 - 11.10	**Session 1.2: China and the Water-Energy-Food Nexus**	***Moderator: GWP*** ***The Nexus in China*** ***1. Implementing the Strictest Water Resources Management System to Secure the Safety of Food and Ecology*** Mrs Shi Qiuchi, Professor, Water Resources Department, Ministry of Water Resources ***2. The Role and Prospect of Hydropower in the Water-Energy-Food Nexus*** Dr. Liu Heng, Director-General, International Center on Small Hydropower, Vice Chair of GWP China Regional Technical Committee ***3. The Farmland, Reservoirs and Food Security Nexus in China*** Dr. Cai Dianxiong, Director of Chinese Academy of Agriculture Sciences and Member of GWP China Regional Technical Committee **Panel discussion**
11:10-11.30	**BREAK**	

Time	Session	Summary
11.30-13:00	**Session 1.3: China and the Water-Energy-Food Nexus**	***Moderator: Mark Smith*** ***1. How a PES supported forest restoration policy connected water-food-energy-evidence from the Conversion of Cropland to Forests Program in China*** Xie Chen, China National Forestry Economics and Development Research Center, State Forestry Administration, Beijing ***2. No Water = No Food & No Power*** Feng Hu, China Water Risk ***3. Water-pocalypse? China's Water Crisis Exacerbated by Coal Development*** Deng Ping, Greenpeace China and Chinese Academy of Sciences ***4. China's South to North water diversion project, climatic variation and human influence*** Dr. Fang Dong, Senior Engineer, China Water Engineering Association **Plenary discussion**
13:00-14:00	**LUNCH**	
14:00-15:30	**Session 1.4: Global Experiences on the Water-Energy-Food Nexus**	***Presentations from around the world on the nexus as it manifests to different geographies, perspectives and problems*** ***1. The nexus and resource scarcity/security in the Amazon*** Helen Bellfield, Global Canopy Programme, Oxford, U.K. ***2. The challenges of the nexus for Asia with a focus on international law*** Dr Patricia Wouters, Professor of International Law, Founding Director, China International Water Law Programme, Xiamen Law School ***3. The risks and opportunities of food-energy-environment-water linkages*** Paul Wyrwoll, General Manager, FE^2W Network, Managing editor Global Water Forum, Crawford School of Public Policy, The Australian National University ***4. The multipurpose water uses of hydropower reservoirs*** Emmanuel Branche, Senior Economist Engineer, Generation & engineering, Sustainable Development Department, Electricité de France **Session Commentator**: Jeremy Bird, Director General, International Water Management Institute,

Time	Session	Summary
		Colombo, Sri Lanka
15:30-16.00	**BREAK**	
16.00-17.30	**Session 1.5: Global Experiences on the Water-Energy-Food**	1. ***Water-Energy-Food Nexus Analytical Framework and Applications*** Bassel Daher, Research Associate Texas A&M University, USA 2. ***Nexus Perspectives in Central Asia*** Dr. Munira Aminova, Vesalius College, Vrije Universiteit Brussels 3. ***U.S. Perspectives and Case Studies on the Water Energy Food Nexus*** Jordan Macknick, US National Renewable Energy Laboratory 4. ***Infrastructure development, food security and ways forward in the Mekong*** Dr. Eric Baran, Senior Scientist, WorldFish, Phnom Penh, Cambodia **Session Commentator:** Dipak Gyawali, Nepal Water Conservation Foundation (TBC)
17:30 - 17:45	**Session 1.6: Synthesis of discussions**	Summary of the day – key points for the nexus – comments from Dr Mark Smith, IUCN
17.45	**Day 1 Close**	
	Dinner: Symposium Dinner, Friendship Hotel	

Day 2, Friday 14 November 2014, ***What Works in the Water-Energy-Food Nexus?***

Time	Session	Summary
09:00-09.15	**Introduction to Day 2**	• Brief Re-cap from Day 1, and explanation of Day 2 activities
09:15 – 10:30	**Session 2.1: Findings from the Synthesis Papers**	***Brief presentations of findings from the Five Synthesis Paper authors*** Introduction to the Synthesis Papers and objective of the session 1. ***'Cleantech' for water, energy and food infrastructure solutions -*** Simon Howarth, Mott MacDonald 2. ***Using the nexus to accelerate social development and support water stewardship and corporate engagement -*** James Dalton, IUCN/Stuart Orr, WWF International 3. ***Influencing pathways of investments for in the nexus -*** Kala Fleming, IBM Research – Africa **Facilitator:** Katharine Cross, IWA
10:30-11:00	**BREAK**	
11:00-12:30	**Session 2.2: Findings from the Synthesis Papers**	4. ***Natural infrastructure/ecosystems in the nexus -*** Todd Gartner, World Resources Institute 5. ***Power dynamics (policy and institutional change/collaboration) across the nexus-*** Dipak Gyawali, Nepal Water Conservation Foundation/Christopher Butler, University of California, Santa Cruz **Facilitator:** Damian Crilly, Environment Agency, UK
12:30-13:30	**LUNCH**	
13:30-15:30	**Session 2.3: Synthesis Paper Best Practice discussion**	• Carousel discussion on synthesis paper findings with paper authors and Dialogue Secretariat
15.30-16:00	**BREAK**	
16:00-17:00	**Session 2.4: Synthesis Papers Best Practice Feedback Session**	• Synthesis author short feedback presentations of key common issues from the carousel discussions
17:00-17:15	**Wrap Up of Day 2 and Close**	

Day 3, Saturday 15 November 2014, ***Identifying Principles for the Nexus***

Time	Session	Summary
09:00-09:15	**Introduction to Day 3**	• Brief Re-cap from Day 2, and explanation of Day 3 activities
09:15-10:10	**Session 3.1 Policy Principles for Multi-Purpose and Multi-Sector Approaches**	• Facilitated group discussions on principles from synthesis discussions, presentations from day, and participant experience
10:10-10:40	**Session 3.2 Policy Principles for Multi-Purpose and Multi-Sector Approaches**	• Presentation of framework and application of policy principles. Discussion.
10:40-11:00	**BREAK**	
11:00-11:40	**Session 3.3: Policy Principles discussion**	• Group discussions of diagnosis of principles. Identification of: ➢ Incentives for policy coherence ➢ Configuration of actors and institutions ➢ Joint visioning & planning ➢ Good examples…
11:40-12:30	**Session 3.4: Policy Principles discussion and review**	• Group presentations on review of the policy principles and recommendations • Panel reflection and review of the principles • Discussion on operational practice and pilot opportunities
12:30-12:45	**Session 3.5 - Review and Conclusions**	• Explanation of next steps and symposium reporting • Closing of the Symposium ➢ James Dalton, IUCN ➢ Katharine Cross, IWA • Participant workshop evaluation
12:45	**LUNCH AND SYMPOSIUM END**	

Appendix Two: Symposium Participants

	Organisation	Country	Name
1	Niger Basin Authority	Cameroon	Henri-Claude Enoumba
2	East Africa Power Pool	Kenya	Joseph Magochi
3	Department of Irrigation, Myanmar	Myanmar	Aye Myint
4	Sanima Hydro	Nepal	Mr Ajoy Karki
5	Environment Agency	UK	Damian Crilly
6	Global Canopy Programme (GCP)	UK	Helen Bellfield
7	Mott MacDonald	UK	Simon Howarth
8	International Water Management Institute (IWMI)	UK	Jeremy Bird
9	University of California, Santa Cruz	USA	Christopher John Butler
10	World Resources Institute	USA	Todd Gartner
11	Lake Victoria Basin Commission	Kenya	Canisius Kanangire
12	Dialogue on Dams - Civil Society representative	Ghana	Richard Twum Barimah Koranteng
13	National Renewable Energy Laboratory	USA	Jordan Evan Macknick
14	Nepal Water Conservation Foundation	Nepal	Dipak Gyawali
15	IBM Africa	USA	Kala Fleming
16	PRCEE,MEP,PR, China	China	Zhe Liu
17	Conservation International	China	Jiexi Feng
18	China Dialogue	China	Xu Nan
19	Greenpeace, China	China	Shuo Li
20	China Beijing Environmental Exchange	China	Tao Lan
21	China Dialogue	China	Zhang Chun
22	US State Department	USA	Aaron Salzberg
23	Jal Bhagirathi Foundation	India	Kanupriya Harish
24	Food and Agriculture Organisation (FAO)	Thailand	Thierry Facon
25	Texas A&M University (TAMU)	Lebanon	Bassel Daher
26	The World Bank	China	Liping Jiang
27	Shanghai Institutes for International Studies	China	Hongyuan Yu
28	Peking University	China	Daojiong Zha
29	Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences	China	Song Xianfang
30	Forest Economic Development Research Center (FEDRC), State Forestry Administration	China	Xie Chen
31	Greenpeace, China	China	Deng Ping
32	Beijing Forestry Society	China	Shen Qianqian
33	Hohai University	China	Shi Guoqing
34	AECOM	USA	Gary Lawrence
35	US State Department	USA	Natalie Beckman
36	AFC Consultants International	Netherlands	Rieks Bosch
37	Verje University of Brussels and Executive Director of Central Asian Research and	Belgium	Munira Aminova

	Development Network (CADN)		
38	Global Water Partnership (GWP) China	China	Zheng Rugang
39	Global Water Partnership (GWP) China	China	Ma Yilin
40	International Center on Small Hydro Power and GWP China Regional Technical Committee	China	Liu Heng
41	Chinese Academy of Agriculture Sciences and GWP China Regional Technical Committee	China	Cai Dianxiong
42	Upper Mun River Basin Management Division of the Department of Water Resources	Thailand	Kergkeart Kumarasingha
43	Ministry of Mines and Energy	Cambodia	Bun Narith
44	Hydropower Planning Office	Cambodia	Son Davin
45	WorldFish Center	Cambodia	Eric Baran
46	Ministry of Water Resources, PR.China	China	Shi Qiuchi
47	China Water Risk	China	Feng Hu
48	German Development Cooperation (GIZ)	Germany	Gerhard Rappold
49	Xiamen Law School	China	Patricia Wouters
50	University of Wuhan	China	Wang Jinpeng
51	Information Center for Agriculture and Rural Development	Vietnam	Dang Kim Khoi
52	Water Resources University of Vietnam and also a focal point for Vietnam in CAPNET	Vietnam	Nguyen Mai Dang
53	Lao Institute for Renewable Energy (LIRE)	Laos	Aurelie Pelletreau
54	International Centre for Integrated Mountain Development (ICIMOD)	Bangladesh	Golam Rasul
55	Sinohydro	China	Liu Fengqiu
56	China Dialogue	China	Yue Wang
57	AECOM	China	Shi Liang
58	China Business Council for Sustainable Development (CBCSD)	China	Ji Qing
59	Mott MacDonald	China	Zhang Yi
60	Duke Energy Egenor	Peru	Julio Velasquez
61	China Water Engineering Association	China	Fang Dong
62	Institute for Climate and Sustainable Cities (ICSC)	Philippines	Angelo Kairos Torres Dela Cruz
63	United Nations Economic and Social Commission for Asia and the Pacific (UN ESCAP)	Malaysia	Salmah Zakaria
64	Comisión Económica para América Latina (CEPAL)	South America	Caridad Canales Davila
65	International Food Policy Research Institute (IFPRI) China	China	Claire Hsu
66	World Resources Institute (WRI) China	China	Zhong Lijin
67	World Resources Institute (WRI) China	China	Xiaotian Fu
68	University of Cambridge, Engineering Department	China	Ying Qing
69	University of Cambridge, Department of Geography	China	Keith Richards

70	Economic and Social Research Council	China	Grace Mang
71	International Union for Conservation of Nature (IUCN)	Switzerland	Mark Smith
72	International Union for Conservation of Nature (IUCN)	Switzerland	James Dalton
73	International Water Association (IWA)	Thailand	Katharine Cross
74	International Water Association (IWA)	China	Tao Li
75	International Water Association (IWA)	China	Dan Wang
76	International Water Association (IWA)	China	Jessica Li
77	International Water Association (IWA)	Netherlands	Carolina Latorre
78	Junta de Vigilancia Huasco – Chile	Chile	Victor Gonzales
79	Royal Institute of Technology (KTH) Stockholm	Sweden	Dimitris Mentis
80	Electricité de France (EDF)	France	Emmanuel Branche
81	Crawford School of Public Policy, Australian National University (ANU)	Australia	Paul Wyrwoll
82	China Water Risk	China	Hubert Thieriot
83	Institute of Geographical Sciences & Natural Resource Research, Chinese Academy of Sciences	China	Xia Jun
84	Crown Agents, Evaluator	USA	Peter Whitford
85	Crown Agents, Evaluator	USA	Stanley Peabody

Appendix Three: Carousel Discussion Feedback

Carousel Discussion

Synthesis Paper 1 Cleantech for water, energy and food infrastructure solutions

1. What are the strategic entry points (opportunities) for the theme to create connections between water-energy-food?

- Seek funding by public sector in clean technology
- Small hydropower
- Bio-fuel/bio-fertilizer

2. What is the applicability of the theme to different context and scales?

- The use of new technology may because a source of social instability, e.g. to increase the gap between poor and rich, highly developed and less developed region

3. What policies, regulations, legal framework and incentives (enabling conditions) does this theme need for cross-sectoral opportunities?

- Technology transfer to China
- Government subsidy for technological innovation
- Capacity development and education
- The necessity to look at long life-cycle when evaluate cleantech
- Performance based contracts are a way to do this – companies pay for capital costs upfront for increased efficiency and get returns through the money saved. This doesn't work if there are perverse incentives. However, there are many examples of it working such as in Thailand with installation of pumps in wastewater treatment plants which get a return in 6 months

4. Additional cases, best practices and recommendations

- Law on feed in tariffs in Jordan – farmers switch to solar production from crops, because water is needed for domestic use. The energy produced can be sold to the grid
- Arid islands of Greece which use renewable energy for desalinization
- Wastewater treatment plants becoming energy producers or at least energy neutral

Carousel Discussion

Synthesis Paper 2 Using the nexus to accelerate social development and support water stewardship and corporate engagement

1. What are the strategic entry points (opportunities) for the theme to create connections between water-energy-food?

- Use wastewater as alternative resource (e.g. use of water from ice cream factory)
- Influence businesses through pricing and corporate image. Stewardship more attractive to those that have an image to maintain
- Cross-sectoral assets investment
- Sensitize business to meet local needs

2. What is the applicability of the theme to different context and scales?

- Farmers have to be good stewards of natural resources because of livelihoods (at individual scale), but large agricultural business is not as interested in long term sustainability – the need of possible window for stewardship at large business scale
- In countries like China, some companies also have a role in providing public service and goods. conflict between market (profit) and social responsibility (sometimes voluntary)

3. What policies, regulations, legal framework and incentives (enabling conditions) does this theme need for cross-sectoral opportunities?

- Smarter procurement – need to understand supply chains
- Enhance the role of government in regulation enforcement in business world, e.g. in Thailand the biggest risk for private sector and developers of infrastructure are regulation and politics.
- Government is expected to stand out to hold companies accountable for their behaviours.
- For private companies, find balance of independence (flexibility) and accountability

4. Additional cases, best practices and recommendations

- Trading of efficiencies e.g. white certificates for energy efficiencies in France

Carousel Discussion

Synthesis Paper 3 Influencing pathways of investments for the nexus

1. What are the strategic entry points (opportunities) for the theme to create connections between water-energy-food?

- Cross-geographical investment
- Moving from public to private entities
- Donors (drive investment direction)
- Flood-control project

2. What is the applicability of the theme to different context and scales?

- Need to have knowledge of local context
- Rule of law
- Accountability

3. What policies, regulations, legal framework and incentives (enabling conditions) does this theme need for cross-sectoral opportunities?

- Guidelines needed to be holistic – developed through dialogue
- Evaluation framework. What's the priority? Which project should go first? What's the scale?
- Influencing investments –
    - need to know baseline
    - awareness of link between water, energy, food
- Nexus assessment to be able to quantify issues and where investments should focus

Options in governance mechanism. Top-down or bottom-up?

4. Additional cases, best practices and recommendations

- There is need for leadership to integrate different sectors and groups in the decision-making
- Funding and donors
- Regional vision
- Long term planning

Carousel Discussion

Synthesis Paper 4 Natural infrastructure in the nexus

1. What are the strategic entry points (opportunities) for the theme to create connections between water-energy-food?

- City planning (quick response to risks)
- Green infrastructure
- Natural capital infrastructure
- Combination of contracted and natural infrastructure

2. What policies, regulations, legal framework and incentives (enabling conditions) does this theme need for cross-sectoral opportunities?

- When making policies, it is important to consider a series of questions:
    - who owns the infrastructure
    - What are the ways to secure it?
    - How to assess where to invest: natural infrastructure or people?
    - What are the costs of investing? (Does it involve taxes?)
    - Why there aren't many project investing in natural infrastructure?
    - Is there a lack of analysis?

3. Additional cases, best practices and recommendations

- There is need for leadership to integrate different sectors and groups in the decision-making

Carousel Discussion

Synthesis Paper 5 Power dynamics across the nexus

1. What are the strategic entry points (opportunities) for the theme to create connections between water-energy-food?

- Find common grounds between water, energy and food
- Institutional reforms
- Look at benefit sharing rather than trade-offs

2. What is the applicability of the theme to different context and scales?

3. What policies, regulations, legal framework and incentives (enabling conditions) does this theme need for cross-sectoral opportunities?

- Dialogue with representatives from different sectors, not necessary to always have all three sectors at the same time, but based on specific situation to gather most relevant stakeholders, including those who hold different opposing ideas, for the communications)
- Communication strategy – needs to be geographically specific

4. Additional cases, best practices and recommendations

- Use of different communications tools to convey messages to different audiences; shape communication for wider influence, e.g. Cambodia – newspaper advertising of issues;
- Identify factors that have influences on decision-makers; do surveys to assess opinions and to determine level of influence

Appendix Four: F.O.R.C.E Framework Group Discussions

F.O.R.C.E framework **Group One**

	F.O.R.C.E framework **Group One Technologies**
Framing:	How to define nexus? • Nexus technologies provide extra advantages which not only target single problem in one particular sector, but also benefit the trade-off analysis and the optimization of resource allocations cross sector.
Opportunity: ***What is the opportunity for joint action and how can this be encouraged?***	What are the financial and non-financial incentives for joint action to develop and access new technologies? • Poverty, climate change, urbanisation and population growth threat the water-energy-food security. However, they are also catalyst for action and innovation in the research and development of new technologies in nexus. These technological innovation and initiatives will in turn contribute to tacking the challenges in nexus. • SIDS (Small Islands Developing States) • Some the technologies and practices have great potentials in the future, for instance. - LDC- skip old development model - ISD Inclusive Sustainable Development - Government subsidy for technological innovation - Innovative financing
Robustness: ***What is the capacity of the regulatory/incentive framework(s) to effectively control the different uses?***	What are the controls of technologies which minimize negative impact on other sectors? (e.g. competition for water availability) • To promote the development of small hydropower; solar, wind, and nuclear power; desalination • Linkage between water-energy and food: use solid waste and waste water to generate bio-gas and to

F.O.R.C.E framework **Group One Technologies**	
	irrigate lands. • Use offline wind power and solar power for desalination • Solar pump for irrigation, cooling, heating, and drinking • At the same time it's necessary to avoid overuse of resources and to increase efficiency, which will determine whether the dynamic in technologies can maintain in the long-run. • Drone—saving energy—produce fertilizer and pesticides • Drip irrigation • Establish monitoring and measuring system, and promote water meters in irrigation to collect more accurate data on water consumption in different sectors and water loss.
Convergence: ***Is there any coordination (within the sector – and between sectors) in prioritizing what is required?*** ***Is there collaboration between different sectoral objectives?***	How do you assess the impacts across sectors when deciding on the application of new technologies? • The nexus approach emphasizes cross-sectoral cooperation. However, the interest of each sector conflicts. How to promote understandings of each sector and pursue mutual benefits of nexus projects • Assessment tools to quantify the trade-offs with objective data • Evaluation framework with the engagement of stakeholders from each sector
Effectiveness ***What is the effectiveness of a multi-sector approach?*** ***E.g. immediate benefits and knock on effects***	What examples are there of technology being adapted, adopted and appropriated? • The maintenance of technologies is as important as the development of new technologies. Developing countries should re-allocate human and financial recourses to promote capacity building and education • Mobilize the application of technologies that benefit nexus security Take advantage of the social media, scheme of shaming (fine, punishment etc.)and gamification (government subsidy, media coverage etc.)

F.O.R.C.E framework **Group Two**

F.O.R.C.E framework **Group Two Corporate engagement**	
Framing:	How to define nexus? What is not nexus? • Reinforce and highlight reality, emphasize practicality and pragmatism • The nexus is nuanced: – Factual (the nexus is everything) – Counterfactual (supply and demand, profit and loss) • Points of connection • Consider externalities, reduce upstream costs, minimise downstream impacts
Opportunity: ***What is the opportunity for joint action and how can this be encouraged?***	What are the opportunities for collaborating across the (water-food-energy) sectors through by improving efficiency of private sector supply chains? Give examples • Role of governments (e.g. enabling environment for Public, Private, Partnerships) • Reduce supply chain impacts • Do the 'right thing; (e.g. resource use 'footprinting') • Use a 'what's in it for me' approach as a way to get the right people around the table • Apply monitoring and technology to demonstrate the evidence for collaborative advantage • Complementarity of Corporate Social Responsibility and Developing Nation Ethos
Robustness: ***What is the capacity of the regulatory/incentive framework(s) to effectively control the different uses?***	What are the incentives for private sector to work multi-sectorally? • Must include legal considerations • Social sanctions • Implementation capacity • Compliance and enforcement mechanisms • Incentives for State Operated Enterprises • Complementarity of multinational corporate and State Operated Enterprises

F.O.R.C.E framework **Group Two Corporate engagement**	
Convergence: ***Is there any coordination (within the sector – and between sectors) in prioritizing what is required?*** ***Is there collaboration between different sectoral objectives?***	What are examples of the private sector engaging in inter-sectoral problem solving? How can this type of engagement help private sector understand and manage risks? Provide examples • Upstream – downstream water rights trading • Trans-boundary water energy swaps • Transition from State Operated Enterprises to listed private corporate • National nexus policies • Nexus style investments into natural resource research and development • Investments in natural infrastructure
Effectiveness ***What is the effectiveness of a multi-sector approach?*** ***E.g. immediate benefits and knock on effects***	What is the role of the private sector in driving adaptation, adoption and appropriation of multi-sector approaches? Examples of effective convergence around nexus corporate stewardship are: • Upstream – downstream water rights trading (China) • Trans-boundary water energy swaps (East Africa Power Pool, West Africa Power Pool) • Transition from State Operated Enterprises to listed private corporate (Angian Plant Protection Stock Company, Vietnam) • National nexus policy considerations (Thailand) • Nexus style investments into natural resource research and development (Paraguay) • Investments in natural infrastructure (Ecuador, Fonagua)

F.O.R.C.E framework **Group Three**

F.O.R.C.E framework **Group Three Influencing pathways of investments**	
Framing:	• A positive definition of the nexus is essential • The nexus concerns resources, not outputs
Opportunity: ***What is the opportunity for joint action and how can this be encouraged?***	Are there any inter-sectoral platforms to organise collaborative investments? • Common data platform (shared and open) => leading to technical diplomacy •
Robustness: ***What is the capacity of the regulatory/incentive framework(s) to effectively control the different uses?***	What type of regulation is needed to encourage investment flows for joint water-energy-food nexus projects? • Ministries in water and environment do need to become more powerful in the sense that they need resources, greater influence, more regulatory tools and mandates, and better water law that has influence and control over energy use and abstraction of water for example • Capacity building to national governments (as an entry point) to understand and accept the nexus conceptual approach and demand
Convergence: ***Is there any coordination (within the sector – and between sectors) in prioritizing what is required?*** ***Is there collaboration between different sectoral objectives?***	What are the incentives for investors to coordinate their investments in multi-sector projects? • Learning by doing (field realities) is critical to influence policies from the bottom-up and top-down. Researching the nexus has to be relevant to the nexus in terms of impact, and move beyond the conceptual discussions. • Needs to be greater monitoring of effective policies, perhaps through case studies • External crisis, like economic recession, floods, droughts • Bottom up technical cooperation between "siloed" departments/agencies can drive joint action
Effectiveness ***What is the effectiveness of a multi-sector approach?*** ***E.g. immediate benefits and knock on effects***	What makes an effective multi sector investment? • Integrative team with all skills (avoid silos): - Right team = right solution - Cohort focus - Common understanding

F.O.R.C.E framework **Group Four**

Group Four—Natural infrastructure/ ecosystems	
Framing:	• The nexus can be a distraction and difficult to define • Engineered approach can move away from interlinkages, whereas the scope of natural infrastructure requires involvement across sectors (nature is the nexus) • Groundwater is part of natural infrastructure (and by extension interacts with water-energy-food) • Look at scale can implement interlinkages • Nexus is a change of attitude and can demonstrate benefits of actions in one areas on another • Not nexus – when not interacting with other sectors
Opportunity: ***What is the opportunity for joint action and how can this be encouraged?***	What are the financial and non-financial incentives for joint action to invest in natural infrastructure? • Leverage financing opportunities • EIAs which touch on all 3 sectors • Nexus brings in options of developing rural economy (identifying alternatives) • Enhances options for (diversification) of rural livelihoods beyond natural resources based livelihoods • Private-public partnership – way to find segments interesting for each • For example, investing in watershed conservation means that there is more potential for agricultural development • Natural capital management increases the value of the watershed • E.g. China – Rural economic development; bringing in energy provides options for investing in natural infrastructure • E.g. Korea – intensification of agriculture has been main economic option, but this needs energy and investment in natural infrastructure to provide water and power • E.g. Storing water in aquifers – need electricity to make this happen (for pumping), and then don't need storage reservoirs upstream • E.g. LVBC Developing forestry; brining in private sector to develop the diary value chain (also promoting conservation agriculture) • Urban planning framework which take into account the wider landscape (opportunity to consider natural infrastructure) • Forces articulation of impacts on other sectors especially for investors, development banks, etc.

Group Four—Natural infrastructure/ ecosystems	
Robustness: ***What is the capacity of the regulatory/incentive framework(s) to effectively control the different uses?***	What type of regulation encourages green solutions in your development pathways? • Land tenure needs to be secure • Improve accounting of natural infrastructure (baseline is important) • Strategic planning as a regulatory tool (although the problem is implementation) • Use of new methods for monitoring such as remote sensing
Convergence: ***Is there any coordination (within the sector – and between sectors) in prioritizing what is required?*** ***Is there collaboration between different sectoral objectives?***	What are examples and suggestions for investing in natural infrastructure which achieves the goals for ecosystem health as well as resource provision (e.g. water supply, energy generation, food production)? • The appropriate incentives are needed to provide for collaboration • An example is through job evaluations – performance evaluation indicators that encourage collaboration across sectors • Economic valuation – identifying what the economic values are for different resources indicates opportunities for investment in natural infrastructure. For example, valuation of groundwater recharge; valuation of wetlands. These can identify the immediate benefits • Collaboration starts with research, budgeting and planning • The terms of reference of environmental studies cam be shaped to consider the impacts on the water-energy-food sectors • Lack of coordination appears during execution, so there is a need to emphasize closed loops so lessons learned can inform planning • Lessons needs to be incorporated into your own context • There are difficulties in cost-benefits analysis of natural infrastructure so there should be options assessments which include quantitative and qualitative approaches to evaluate different possible combinations of solutions
Effectiveness ***What is the effectiveness of a multi-sector approach?*** ***E.g. immediate benefits and knock on effects***	How do you determine the effectiveness is natural infrastructure providing multi sector benefits? Count it, Change it, Scale it • Need to have the right information to effectively measure benefits • Willingness to have the long term perspective to see effectiveness • Solutions need to be technically feasible, economically reliable and politically acceptable to be effective. For example – if the energy grid is to be restructures then other sectors need to be involved

F.O.R.C.E framework **Group Five**

F.O.R.C.E framework **Group Five-- Power dynamics (policy and institutional change/collaboration)**	
Framing:	How to define nexus? What is not nexus? • Power dynamics help to identify what are the incentives for a project to be multipurpose. Power dynamics are important not only between actors but also within the sectors or within an organization.
Opportunity: ***What is the opportunity for joint action and how can this be encouraged?***	What opportunities are there to make institutions collaborate despite varying degrees of power? • To facilitate consensus with a nexus approach, power dynamics can be better dealt with if the differences between power is reduced (with inclusion of all stakeholders) • E.g. Rotterdam port involved the environmental organizations before the project was agreed to avoid delaying the implementation once approved. This approach may take more time than usual but long term it is faster and more cost effective.
Robustness: ***What is the capacity of the regulatory/incentive framework(s) to effectively control the different uses?***	What are the non-regulatory incentives for institutions to work together on projects which deliver multiple sector benefits? e.g. institutions identifying risks and mobilizing ways to reduce them which is not through regulation • Flexible institutions allows more room for manoeuvre and can therefore more dynamically integrate and deliver multiple sector benefit in the process of looking for nexus solutions. • Public opinion needs to be taken into account before other actors get together but dialogue can be in different levels. • In the international or transboundary contexts, agreements usually are not given enough time to enable a better incorporation of all stakeholders' interests. There is need for agreements that allow flexibility to modify the projects giving some space for negotiations with stakeholders.

F.O.R.C.E framework **Group Five-- Power dynamics (policy and institutional change/collaboration)**	
Convergence: ***Is there any coordination (within the sector – and between sectors) in prioritizing what is required?*** ***Is there collaboration between different sectoral objectives?***	What does effective collaboration between institutions for multi sector benefits look like? e.g. Joint identification, action, mobilisation and investment • Interest of stakeholders can be explained as - Civil society – beneficiaries, has particular needs - Investors – profit - Technical experts – technique - Government – political influence • To bring all parties to a common point it is important to find 'selling points' • There is need for including different expertise (participants) into the decision making process e.g. building multidisciplinary teams for the design of the project.
Effectiveness ***What is the effectiveness of a multi-sector approach?*** ***E.g. immediate benefits and knock on effects***	What triggers political and economic response to make change? How can this effectively be harnessed for multi sector benefits? • There are no general incentives to all stakeholders. • A functional (institutional) approach is needed instead of a principle approach. • The approach to solve power dynamics will depend from one country to another according to the level of development. • Public opinion needs to be taken into account before other actors get together but dialogue can be in different levels.

Appendix Five: Evaluations

EVALUATION OF SYMPOSIUM ON INFRASTRUCTURE SOLUTIONS IN THE WATER-ENERGY-FOOD NEXUS
13-15 November 2014

	A.	Introduction to the Nexus (Day 1 – Session 1.1)	Agree			Disagree
	1.	The presentation about the global Dialogue on the Nexus was clear and provided a good basis for understanding the water, energy and food nexus concept	1	2	3	4 5
	2.	The video about the global Dialogue was interesting and informative?	1	2	3	4 5
	3.	Information on the outputs of the previous workshops were informative and improved my understanding of the purpose of this workshop	1	2	3	4 5
	B.	Nexus presentations (Day 1 – Session 1.2 – 1.5)	Agree			Disagree
	1.	The series of presentations on the **Nexus in China** gave me a clear picture of what the nexus means in China	1	2	3	4 5
	2.	The series of presentations on **Global Experiences on the Nexus** provided information on how the nexus is understood in different countries and regions	1	2	3	4 5
	C.	Findings from the Synthesis Papers (Day 2 – Session 2.1)	Agree			Disagree
1	The presentations on the series of Synthesis papers provided a clear perspective of :					
	a.	sectoral and integrated best practice; and highlight	1	2	3	4 5
	b.	identify and analyse the main drivers for joint solutions	1	2	3	4 5
	c.	entry points and opportunities for cross-sectoral collaboration	1	2	3	4 5
	d.	Key factors for an appropriate enabling environment to allow cross-sectoral opportunities	1	2	3	4 5
	D.	Group work - Carousel discussion	Agree			Disagree
	1.	The process of discussing the draft paper with each author as the group moved between tables was a useful exercise to better understand all topics and straightforward to follow.	1	2	3	4 5
	2.	What could be improved and made clearer?				
	3.	Using the guiding questions for discussion help me to build up on other groups inputs and understand the importance of dialogue	1	2	3	4 5
	4.	What could be improved and made clearer?				
	E.	Policy Principles discussion (Day 3)	Agree			Disagree
	1.	The Flexibility, Opportunity, Robustness, Coherence, Extent (F.O.R.C.E) framework was clear	1	2	3	4 5
	2.	The Flexibility, Opportunity, Robustness, Coherence, Extent (F.O.R.C.E) framework was a useful framework to shape and identify solutions for water-energy-food	1	2	3	4 5
	3.	What could be improved and made clearer?				
	4.	The feedback process on the F.O.R.C.E framework provided useful insights and discussion	1	2	3	4 5
	5.	What could be improved and made clearer?				

F. Follow up	Agree				Disagree
1. Are you likely to circulate information from this symposium and Nexus Dialogue on Water Infrastructure Solutions?	1	2	3	4	5
2. Will you and your colleagues be motivated to contribute case studies and tools to the Nexus toolkit?	1	2	3	4	5
How will you use the information from the symposium?					
Can we include your email address in our distribution list?					
Can we distribute video and photograph images of the symposium (that have you in them)?					
Additional comments					

Results in percentages