TRACTEBEL
ENGIE

Sustainable Engineering Enabling Transformational Change

Driving Climate Change Mitigation & Adaptation Solutions

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Driving Climate Change Mitigation & Adaptation Solutions

Executive Summary

As the world is undergoing a rapid transformation, we all face common challenges: to mitigate impacts of climate change and ensure access to sustainable, affordable and reliable energy, water and smart infrastructure.

The Paris Agreement of 2015 sets out the global goal and recognizes the overall challenge to protect and reduce vulnerability of people, livelihoods and ecosystems. The 2030 Agenda for Sustainable Development adopted by all United Nations Member States in 2015, also urges for a call for action to combat climate change and its impacts.

Building resilience requires developing sustainable tools and adaptive approaches to effectively respond to the cross-sectoral challenges to save lives and livelihoods.

In this document we share a compilation of references on how Tractebel enables their clients to take action towards reaching UN Sustainable Development Goals and how we drive transformation change through sustainable engineering solutions.

About Tractebel

solar
15+GW

wind
100GW+
(80GW onshore, 20GW offshore)

250GW
of installed **hydropower** capacity

1,5M
hectares of **irrigated lands**

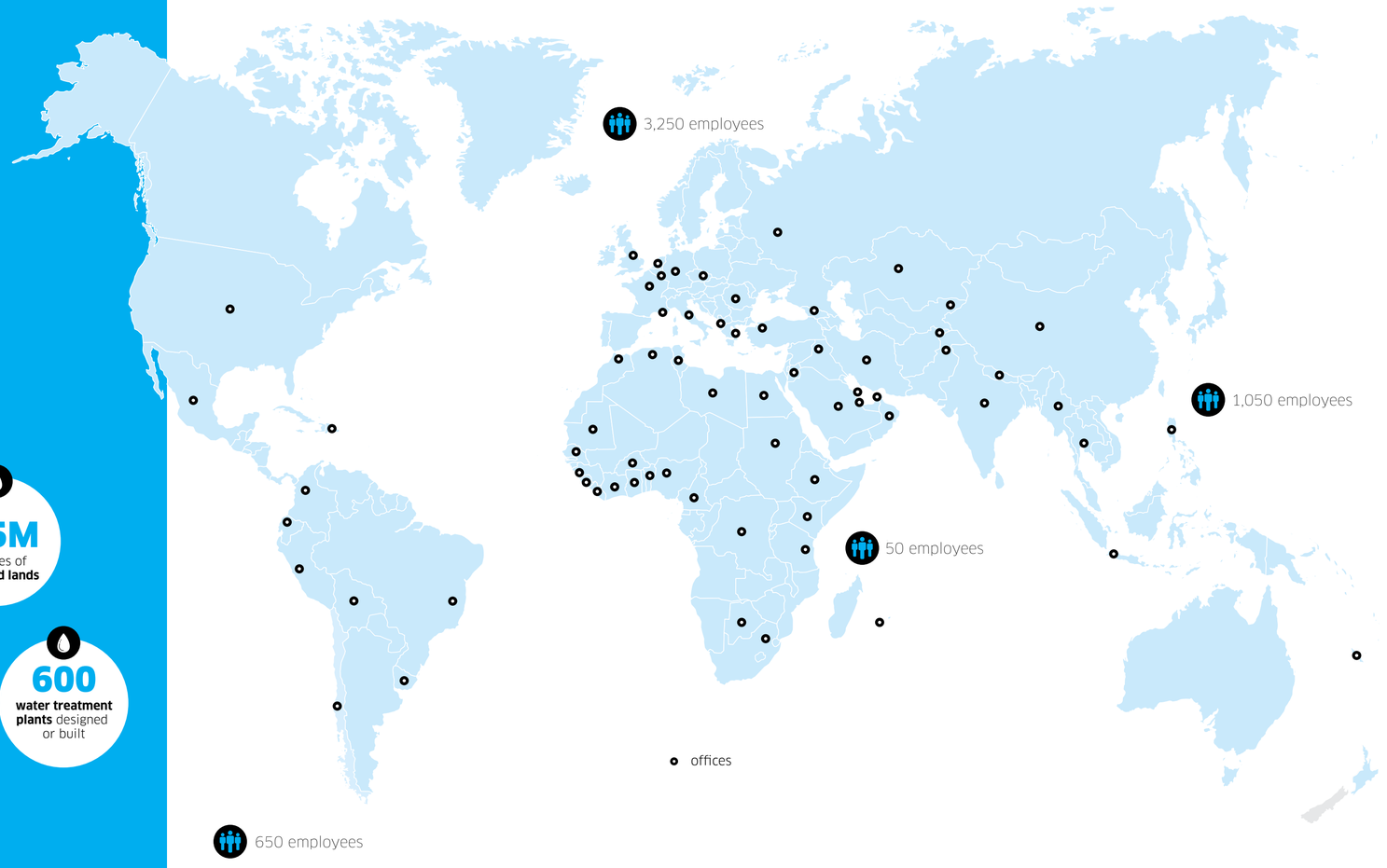
60
million people served with safe drinking water

40
million people served with wastewater collection systems

600
water treatment plants designed or built

+70
countries

Tractebel is a global engineering company providing worldwide life-cycle consultancy and engineering solutions within Energy, Water, and Urban projects.



TRACTEBEL ENGIE

Cities & Urban Development

Structuring city morphology to protect lives, health and critical assets from climate change risk.

Today, some 55 percent of the world lives in cities, and a quarter of all humans live in the 2,500 most populous cities. By 2050, as the global population swells and urbanizes, about 70 percent of people will live in metropolises [1].

Climate change causes a wide range of natural and manmade stresses, having the potential to threaten the very livability of our cities. But, if well managed, cities offer important opportunities for addressing the challenges.

In the face of change and vast uncertainty, transformative approaches that stimulate flexibility, creativity, diversity and innovation are needed to safeguard our cities as secure and thriving places for people to live. Adaptability is the basis for the (re-) new(-ed) resilient urban environment, not only to become responsive to climate change with only a residual risk associated, but also to remain attractive.

[1] UN The 2018 Revision of the World Urbanization Prospects

- SMART & COMPLEX BUILDINGS
- URBAN DESIGN & MASTER PLANNING
- ENVIRONMENTAL, SANITATION & SOCIAL PROGRAMS

Project: Strengthening Climate Change Resilience

Location: Raipur & Kakinada, India

Period: 2018 - 2019

Expertise:
Within the framework of India's Smart Cities Mission Projects, advanced climate risk and vulnerability assessments were conducted by Tractebel, aiming to improve the urban infrastructure and services in Raipur & Kakinada.

Developing Disaster-resilient Infrastructure in India

India's aging infrastructure has been put in the spotlight with recent extreme weather events, reporting a 66% of total public sector losses all related to infrastructure damage.

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Economic growth goes hand in hand with infrastructure, the country's manufacturing industry and growing population, require reliable power supplies, safe roads, efficient railways, ports and airports. Extreme weather changes increase the vulnerability of urban infrastructure. Heat waves, cold waves, flooding, extreme storms and winds, can accelerate the deterioration of urban spaces making them less reliable.

Developing disaster-resilient infrastructure has become a main priority for local governments as they seek to enhance economic growth, job creation, while safeguarding day-to-day activities and movement of their citizens.

- SMART & COMPLEX BUILDINGS
- URBAN DESIGN & MASTER PLANNING
- ENVIRONMENTAL, SANITATION & SOCIAL PROGRAMS

Project name: Guidelines for climate change adaptation in Flanders

Location: Flanders, Belgium

Period: 2015 – 2016

Expertise:
1. An in depth study to assess the impact of climate change scenarios in the spatial structure
2. Creation of guidelines and toolkit for spatial planning and urban development

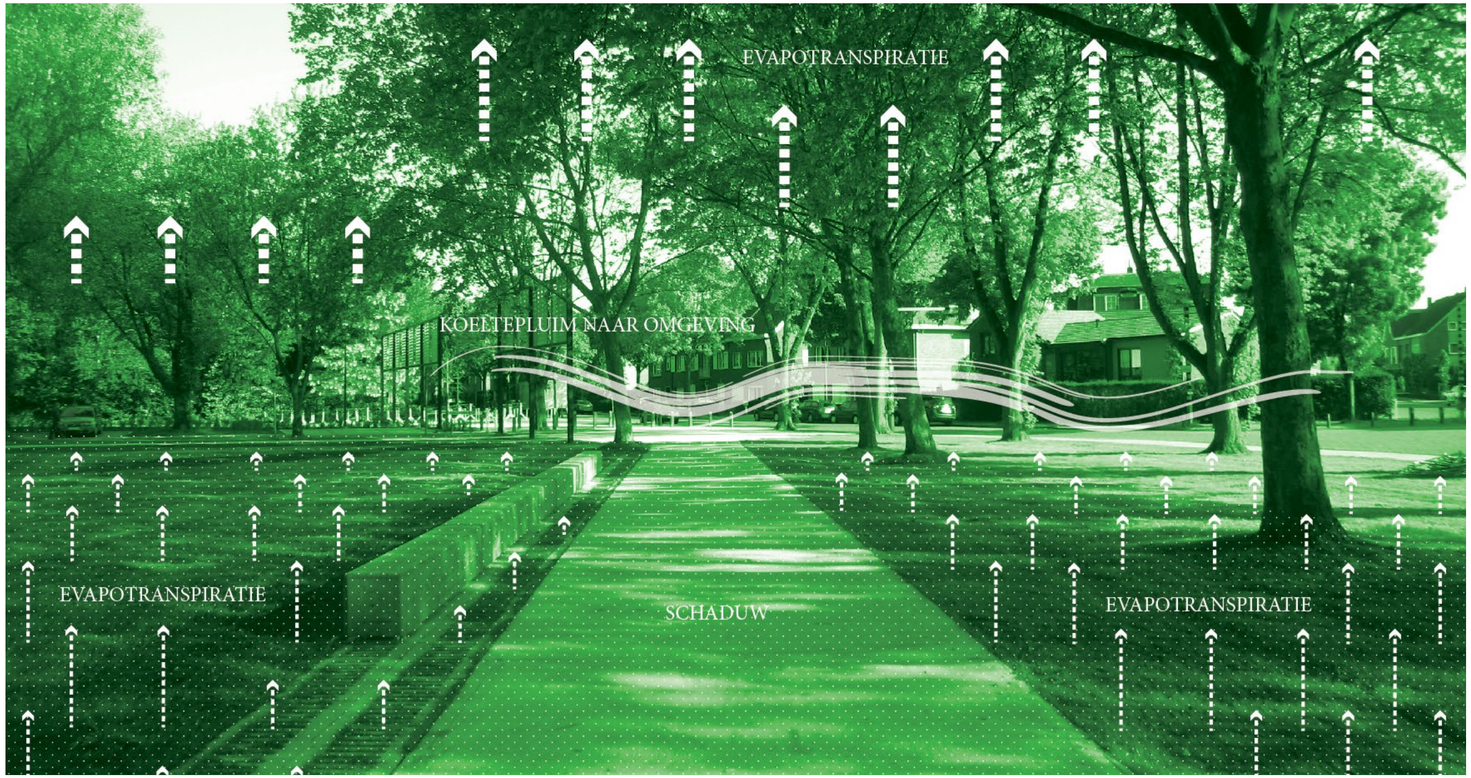
Client: Flemish Government

Sponsor: RWO

Developing Climate-proof Cities

In response to the urge to fighting climate change and its impact, the Flemish Government undertook the challenge to develop a Flemish Climate Vision for 2050. As part of this initiative a set of guidelines and a practical toolkit providing solutions for adaptation in spatial planning and urban development was created.

The toolkit includes spatial strategies and climate-proof spatial design principles to build resilient urban spaces by mapping vulnerability based on different climate change scenarios.



Mobility & transportation

Anticipating climate change impacts on transport infrastructure to adapt urban mobility.

As the overall population continues to grow worldwide, urban areas continue to expand, resulting in large cities becoming even larger. Mobility & transportation are crucial as citizens are required to move for employment, education and leisure. Transportation is the second largest contributor to CO2 emissions globally. [1]

In Europe, urban mobility accounts for 40 % of all CO2 emissions of road transport and up to 70 % of other pollutants from transport. [2]

Efficient and effective mobility and transport solutions need to be developed in order to become smarter and more sustainable while diminishing pollution, decreasing traffic congestion, increasing people's safety, and improving transportation speed and costs.

[1] World Resources Institute, 2017
[2] European Commission Mobility and Transport

- SMART & COMPLEX BUILDINGS
- URBAN DESIGN & MASTER PLANNING
- ENVIRONMENTAL, SANITATION & SOCIAL PROGRAMS

Modernisation of Rail Line in Romania

Rail is not only environmentally friendly and energy-efficient – it is also the only mode of transport to have almost continuously reduced its CO2 emissions since 1990. Upgrading 89.5 kilometers of double-track railway line in Romania, is a step forward towards sustainable mobility, but it also means revamping the region's economy. Connecting two economic areas, Sighisoara to Coslariu brings significant benefits to citizens and subsequently businesses.

Trains are now traveling at a maximum speed of 160 km/h. The route serves as an important connection with faster service making it far more attractive and competitive for freight transport. Passengers too can now enjoy faster travel times, safety and comfort while contributing to a better environment.

Project: Modernisation of the Brasov-Hungarian railway line

Location: Romania

Period: May 2017 – Dec 2017

Expertise:
Tractebel assessed the vulnerability of the railway modernisation project to climate change and extreme weather events.

Client: The European Investment Bank (EIB)

- **TRANSPORT & MOBILITY**
- **ENVIRONMENTAL, SANITATION & SOCIAL PROGRAMS**

Project name: Silent and Sustainable Deliveries in Belgium

Location: Flanders Region, Belgium

Period: 2015 - 2016

Expertise:
Tractebel built a Regulatory Framework providing specific steps and recommendations for silent deliveries that included:
1. Adapted transport equipment
2. Infrastructure modifications
3. Adapted vehicles
4. Behavior of distributors and transporters

Client: Flemish Government: Mobility and Public Works

Silent, Sustainable Deliveries in Belgium

Efficient urban logistics can severely reduce road occupation by freight transport and CO2 emissions in and surrounding urban areas. Most grocery stores in Belgium have their products delivered by road, representing 20% of road traffic, 30% of the road occupation and responsible for 30% of CO2 emissions in urban areas.

PIEK2, a project lead by the Flemish Government in Belgium, aimed at measuring the impact of freight transport on environmental conditions. The project consisted in delivering during early mornings or on late evenings in order to avoid heavy traffic. The research showcased positive climate change outcomes, and as a result, the Flemish Government adapted the noise standards for deliveries to large supermarkets.

The outcomes include optimization of road traffic, enhanced road safety, and the reduction of fuel consumption and harmful emissions. On a one year basis direct environmental benefits account for the reduction of more than 57 tons of CO2 emissions.

- **RENEWABLES**
- **ENERGY SYSTEM CONSULTING**

- **TRANSPORT & MOBILITY**
- **ENVIRONMENTAL, SANITATION & SOCIAL PROGRAMS**

Project name: Zero Emission Valley

Location: Rhône-Alpes, France

Period: 2017 - 2023

Expertise applied include:
1. Feasibility study of a supply chain of hydrogen road delivery
2. Project sizing and cost calculation
3. Drafting of specifications

Client: Hympulsion, a collaboration between the region Rhone-Alpes, Engie and Michelin

Click here for video

The Zero Emission Valley, Leveraging Hydrogen Mobility

Putting the brakes on climate change and meeting the challenges of the energy transition is now more urgent than ever. More and more advances are being made in the use of hydrogen as a source of energy for transport.

The French Auvergne Rhône Alpes region aims at becoming the leading hydrogen territory within France and Europe; setting the example with regard to sustainable development.

The project promotes the launch of 1 000 hydrogen cars, 20 hydrogen stations and 15 electrolyzers, utilizing entirely green energy, as well as facilitating the transformation of local private and public transport.

Energy

The number of people gaining access to electricity has reached 118 million each year since 2010, but these efforts will need to accelerate if the goal is to ensure access to affordable, reliable, sustainable and modern energy for all by 2030. Access to clean energy has critical impact on economic development and standards of living.

Renewable energy is one of the most effective tools we have in the fight against climate change. Renewables are key in a low carbon future. In order to meet the 2° climate goal, the share of renewable energy in the final energy consumption must increase from 19% in 2017 to 65% by 2050. [1]

Nearly two-thirds of greenhouse gas emissions originate from the energy sector, an immediate transformation of the world's energy system with massive uptake of renewables and steadily increasing energy efficiency is crucial to ease the impact of global warming.

[1] IRENA. Global. Energy transformation. A roadmap to 2050. Abu Dhabi, United Arab Emirates. International Renewable Energy Agency; 2018.

- RENEWABLES
- ENERGY SYSTEM CONSULTING
- TRANSMITION & DISTRIBUTION

Project name: Isabela Island Hybrid Solar

Location: Isla Isabela, Galápagos, Ecuador

Period: 2009 - 2020

Expertise:
1. Site investigation and data collection
2. Assessment of existing power plant facilities
3. Demand forecast; design of hybrid power plant system
4. Pre-feasibility study: conceptual design and techno-economical assessment

Client: Ministry of Electricity and Renewable Energy

Click here for video

Renewable Energy For a World Heritage Site

Up until 2007, the Galapagos Islands' inhabitants relied solely on petroleum to meet the increasing needs for energy.

Residents of the Galapagos archipelago successfully replaced the production of electrical energy and transportation from a 100% dependency on fossil fuels to a community based on 100% renewable and low/non-polluting resources.

The Isabela Hybrid project, inaugurated in 2018, today consumes 34 percent less fuel than the old thermal power plant, saving 1,400 tons of CO_2 per year preserving one of the richest and most diverse marine eco-systems in the world.

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•RENEWABLES

•OFFSHORE INFRASTRUCTURES

Project name: Off-Shore Wind Power in Vietnam

Location: Mekong Delta, Vietnam

Period: 2020 - ongoing

Expertise:

1. Feasibility and design studies
2. Independent energy yield assessment
3. Procurement support
4. Design review
5. Construction supervision
6. Commissioning services

This nearshore project, requires a unique mix of onshore and offshore technologies and construction methodologies, as well as capacity building capabilities in a country that has very limited experience with developing offshore wind projects.

Client: Refrigeration and Electrical Engineering (REE)

Praising the Wind Power Potential in Vietnam

Vietnam is considered one of the areas with the greatest potential for offshore wind power production in the world, according to a recent **World Bank report** on expanding offshore wind into emerging markets, with average wind speeds of 7-11 meters per second.

With a rising population and greater energy demand, Vietnam is urgently seeking to move away from fossil fuel and increase its share in the renewable energy sector.

To enhance the continuous economic growth of the country, the Vietnamese government aims to produce 10.7% of electricity from renewable sources by 2030, targeting wind power capacity to reach about 1,000 MW by 2020 and 6,200 MW by 2030.

Tra Vinh 3 is a one of the first nearshore wind farm projects in the country, which will be erected in a tidal mudflat area 2 km off the coast of the Mekong delta.

- RENEWABLES
- ENERGY SYSTEM CONSULTING
- TRANSMITION & DISTRIBUTION

Project name: Increasing Access to Electricity in Rural Africa

Location: Ivory Coast, Africa

Period: 2006 - 2008

Expertise:
1. Feasibility study
2. Implementation of distribution network
3. On site construction supervision

Client: Government of Africa

Sponsor: Agence Française de Développement (AFD)

Click here for video

Enabling Energy For All in Africa

Ivory Coast's economy is on the recovery path following a decade of socio-political instability. Economic growth and electricity demand are projected to continue increasing as investment grows in sectors such as manufacturing and mining.

The Government has committed to meeting demand growth by increasing installed generation capacity by approximately 150 MW/ year reinforcing the electrical supply to over 350 villages and neighboring communities by 2020.

As part of their action plan, the country expects to reach a 42% share of renewables, including 26% of hydro. By 2030 the renewable capacity is targeted to reach 3.3 GW.
The environmentally friendly technology applied translates into a reduction of natural gas use, greenhouse gas emissions and the cost of each kWh generated on the grid.

Water

Providing sustainable engineering solutions for the implementation and operation of water infrastructures.

Growing populations and economic development intensify the competition for water. Aggravated exploitation and pollution of scarce and vulnerable freshwater sources like aquifers, rivers and lakes will intensify the threats to drinking water, sanitation and hygiene infrastructure. Even within this decade, more than 2 billion people will be living in regions or countries with absolute water scarcity.

Increasingly volatile temporal and spatial availability and access to water resources calls for robust water infrastructure and sustainable management practices to ensure its vital services to our lives and livelihoods.

6 CLEAN WATER AND SANITATION

13 CLIMATE ACTION

"Water is the medium through which nature and human societies experience most of the impacts of climate change."

Source: UN World Water Development Report 2020

•HYDROPOWER

•RESERVOIRS & DAMS
•FLOOD PROTECTION

Project name: Jirau Hydropower Plant

Location: Madeira River, Brazil

Period: 2008-2017

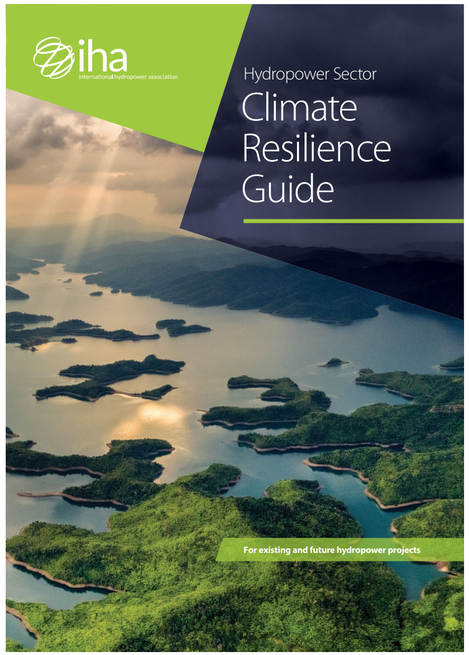
Expertise:
1. Design review
2. Construction management & site supervision
3. Environmental impact assessment

Client: ESBR (ENGIE, Mitsui, Eletrobras Eletrosul, CHESF)

Setting Standards in Hydropower

The run-of-river Jirau Hydropower Plant has a total installed capacity of 3,750 MW, providing power to approximately ten million households, while offsetting approximately six million tons of CO2 emissions annually.

Jirau served as a reference for the **Hydropower Sector Climate Resilience Guide** allowing Tractebel to take part in the drafting of this guide. The guide responds to the need for international industry good practice on how to incorporate climate resilience into hydropower project planning, design and operations.



•WATER TREATMENT AND SUPPLY

Project name: Tunisia, 8 Brackish Water Desalination Plants

Location: Tozeur, Sidi Bouzid, Médenine, Gafsa (4), Kébilli, Tunisia

Period: 2011 - 2014, 2017 - ongoing

Expertise:
1. Rehabilitation and construction of 8 brackish water desalination plants
2. Technical evaluation of desalination techniques
3. Technical and economical evaluation of the use of renewable energy
4. Feasibility study for restructuring the water supply system
5. Environmental impact assessment

Client: SONEDE, Tunisa

Sponsor: KfW, Germany

Transforming Brackish Water to Drinkable Water

Most of the Earth's water - about 97% - is saltwater. As much of the world's population lives in coastal areas, an increasing pressure to utilise this resource has built up.

Modern desalination technologies can remove salt from both seawater and brackish water, therefore providing a new source of freshwater.

Water resources in Tunisia are characterized by scarcity and a noticeable irregularity. By adopting an integrated strategy for the use of water, Tunisia has been able to develop a complex and diverse water infrastructure allowing the country to mobilize and exploit available water resources.

The country has achieved the highest access rates to water supply and sanitation services among the Middle East and North Africa.

•HYDROPOWER

•RESERVOIRS & DAMS
•FLOOD PROTECTION
•IRRIGATION

Project name: Songwe River Basin

Location: Tanzania & Malawi, Africa

Period: 2015 - 2017

Expertise:
1. Feasibility studies
2. Detailed design optimization
3. Contribution to “EAC Vision 2050”

Client: Governments of Tanzania and Malawi

Sponsor: African Development Bank

Transboundary Infrastructures Bridging Water Solutions

With the intention to oversee the management of resources in the river basin for the benefit of people in Tanzania and Malawi, this cross border and cross-sectoral project creates a long-term strategic framework for basin-wide socio-economic development.

The power generated within the river basin aims to benefit 60% of residents in the area. These irrigation schemes will have the capacity to irrigate 3,150 hectares in Tanzania and 3,050 hectares in Malawi allowing farmers to have better crop yields.

The construction of dams will control floods that cause loss of lives and property on both sides of the two countries, and also prevent shifts of the border due to the meandering nature of the river. Environmental conservation of the river and the entire basin were prioritized during the construction of this multi-purpose dam.

Food

Designing new living landscapes with inter connective features able to respond to the fundamental necessity of food production.

Climate change is a major threat to the worlds' food production. Extreme weather conditions, warming temperatures, severe heat, drought, wildfires, and major storms are increasingly disrupting agricultural productivity. Nearly a billion people across the world experience the effects of food insecurity. [1] Recognizing that 75% of the world's poor & food insecure population rely on agriculture & natural resources for their livelihoods, adaptation and mitigation measures need to be implemented in order to reduce the impact on global food production.

[1] Food and Agriculture Organization of the United Nations (FAO) - The State of Food Security and Nutrition in the World 2019

- **WATER TREATMENT AND SUPPLY**
- **IRRIGATION**

Project name: Mahaweli

Location: Mahaweli River, Nuwara Eliya, Central Province, Sri Lanka

Period: 2015 - ongoing

Expertise:
1. Engineering planning & design
2. Construction management & site supervision
3. Strategic Environmental Assessment

Client: Mahaweli Ministry for Development and Environment

Sponsor: Asian Development Bank

Delivering Continued Prosperity in Sri Lanka

The island state of Sri Lanka aims to take better advantage of its water resources. Based on its huge resource, the river can help alleviate the country's water shortages. Key investments are mobilized seeking to address water scarcity, food security, and poverty issues for 6 million people by increasing access to water for irrigation (+103,000 ha) and drinking water supply (+162 MCM/a).

Increasing access to water for irrigation and drinking water supply to 30% of the island's population.

Irrigation water conveyed by the new infrastructure supplies cultivated lands under existing major and minor irrigation schemes. This will increase annual cropping intensity and water productivity throughout the dry season.

- **WATER TRANSFER**
- **IRRIGATION**

Master planning Irrigation in Nepal

Nepal is endowed with enormous water resources potential, but although irrigation is the major water user of the nation, agricultural production relies mostly on erratic rainfall conditions. Farmers often experience unreliable rainfalls and droughts that endangered their crop yields every year.

Besides uncertainty in the availability and allocation of water, the irrigation sector in Nepal is facing new challenges related to population growth, increased food demand, and environmental degradation.

This national-level irrigation masterplan includes an inventory of water use and irrigation policies to understand the natural conditions and operational practices, along with recommendations for practical institutional strengthening strategies as capacity building.

Our assessment of irrigation and water resources technologies and management proposals for rehabilitation and modernization of irrigation operations became instrumental to the sustainable development of the economy and livelihoods of Nepal.

Project name: Irrigation Master Plan

Location: Nepal

Period: 2016 - ongoing

Expertise:
1. Remote sensing & mapping
2. Irrigation and water use inventory
3. Assessment and analysis of land resources
4. Planning and development of hydraulic models

Client: Government of Nepal

Sponsor: Asian Development Bank

Disaster Risk Management

Constantly looking for innovative ways to prevent or mitigate the risks related to natural disasters.

200 million people were displaced by disasters triggered by natural hazards between 2008-2015. [1] In 2018, more than 17 million people fled disasters in 125 countries and territories. Disasters displace three to ten times more people than armed conflict worldwide. With climate change menacing the frequency and severity of natural disasters around the world, it is fundamental to create the abilities to prevent, prepare and recover from the impacts of natural hazards. Reducing the severity of natural disasters is not possible, efforts need to focus in reducing vulnerability and exposure.

[1] IDMC, Global Report on Internal Displacement 2016 (2016)

- **FLOOD PROTECTION**
- **IRRIGATION**

Anticipating Floods & Drought In Flanders

During the past years the region of Flanders in Belgium has faced severe periods of drought and, alternatively, with heavier rainfalls. The recurrence of these two phenomena during the second half of the 19th century urged for the development of systems to give warning and better prepare for water scarcity, drought and flooding.

The flood forecasting and early flood warning systems in Flanders were developed in order to safeguard the population in flood-prone areas and warn them up to 10 days in advance. A similar solution was created for water scarcity in order to to inform the agricultural sector, water-dependent industries and inland navigation by providing a sensible lead time to adjust their processes to mitigate potential economic losses.

Both solutions also help identify and explore sustainable water management solutions in order to address related impacts of the climatic change.

Project name: Digital Solutions for Flanders

Location: Flanders, Belgium

Period: 2014-2015

Expertise:
The development of a hydro-meteorological data exchange and forecasting digital platform.

Client: Flemish Government, Flanders Environmental Agency

•COASTS & ESTUARIES
•FLOOD PROTECTION

Building Coastal Preservation In Africa

West Africa's coastal areas host about one third of the region's population and coastal erosion represents a major environmental problem to them. The loss of land has been caused by the rising sea levels and the destruction of the mangrove forests. Trees and infrastructure have been threatened and are disappearing gradually from towns and villages located close to the shoreline, where most of the economic activity takes place.

By managing erosion, decreasing the number and the impact of floods and protecting the region's biodiversity, the lives of the people living in those coastal areas can be improved significantly.

With the need to preserve the coastal area, the integration of infrastructure and natural resources management in a sustainable way is essential in order to enhance their resilience to climate change.

Project name: West Africa Coastal Area (WACA) - Coastal Erosion Investment Strategy

Location: Benin, Ghana, Ivory Coast and Togo
Period: 2016 - 2017

Expertise:
Development of a framework to assist in the determination of factors threatening citizens, ecosystems, and economic assets along the coast through multi-sectoral digital solutions.

Client: World Bank

•FLOOD PROTECTION

Extreme Climate Conditions Landscaping Nepal

Nepal has been ranked one of the most disaster-prone countries in the world due to its rugged topography and climate conditions. As extreme weather conditions aggravate, the probability of natural disasters increases. Floods are known as one of the most severe and most frequent water-induced natural disasters in Nepal, causing major damage to infrastructures and lives.

In efforts to minimize the impact of water driven disasters, local government contracted experts to produce flood hazard and risk maps in 25 major river basins.

Flood mapping enables the government to make informed, smart decisions on structural and non-structural interventions for flood protection in order to minimize the impact of water-driven disasters. It is also instructive in improving the management of watersheds and water resources infrastructure.

Project name: Flood Hazards in Nepal

Location:

Period:

Expertise:
1. Development of flood hazard and risk maps
2. Feasibility studies
3. Flood-risk management framework

Client: Government of Nepal

Sponsor: Asian Development Bank

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