



# FICHTNER

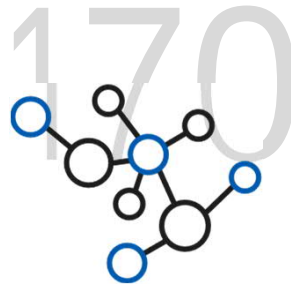
## Company Presentation of the Fichtner Group

**Energy Storage and Renewable Energies in Cambodia**  
**22.11. bis 26.11.2021**

Claus Krebs



Established in 1922 and  
family-owned ever since



Project experience in  
more than 170 countries



Total turnover of  
€226 million in 2020



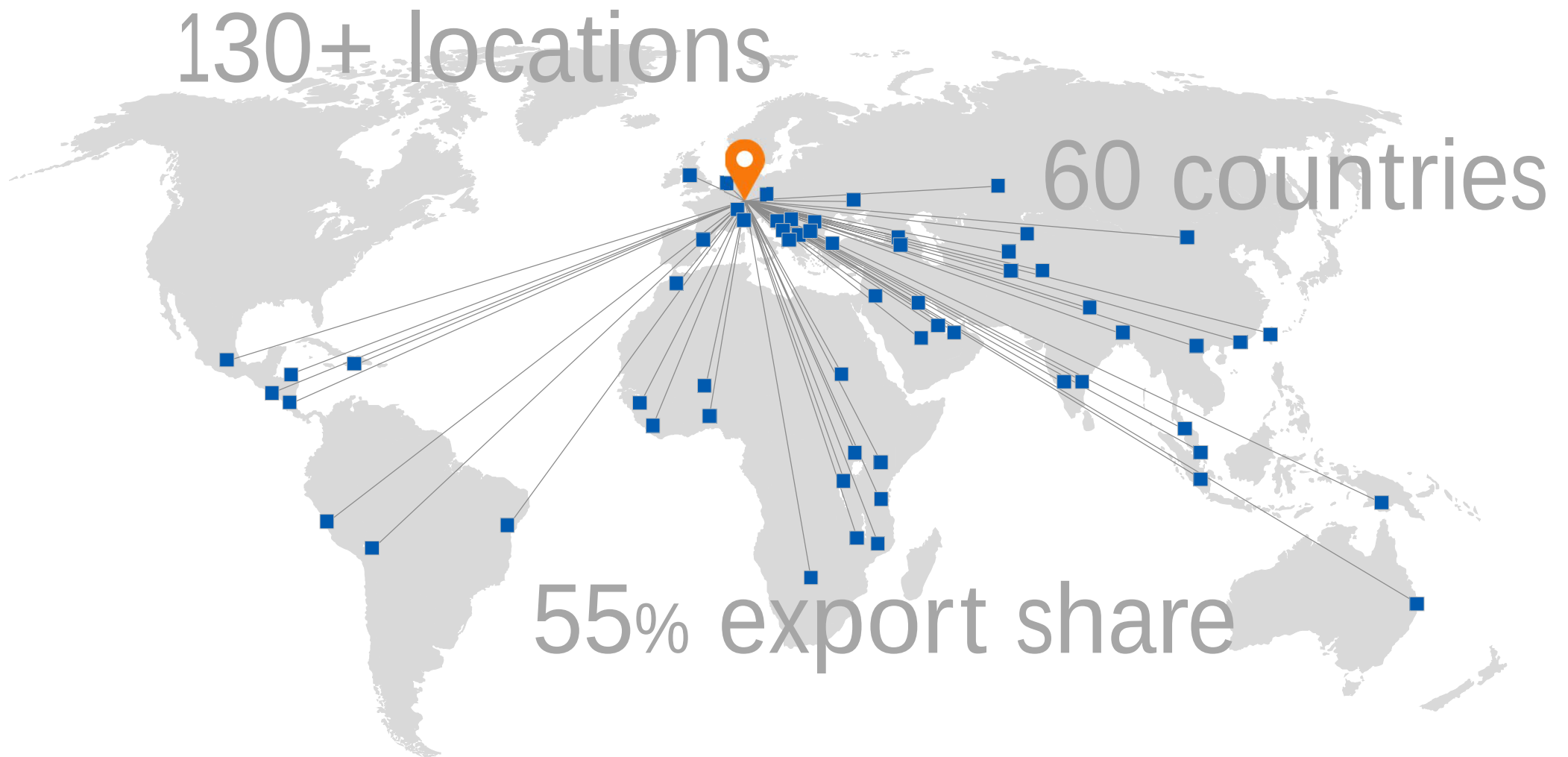
1780 employees  
worldwide – over 800 of  
these in our home office



Long-standing employees  
from 66 nations



Certified systems for quality,  
workplace health, safety, compli-  
ance, environmental protection



Home office in Stuttgart | Present in 60 countries worldwide  
Represented at over 130 locations by subsidiaries and affiliates, branches and project offices  
55% of Group revenues generated outside of Germany

# Asia & Oceania

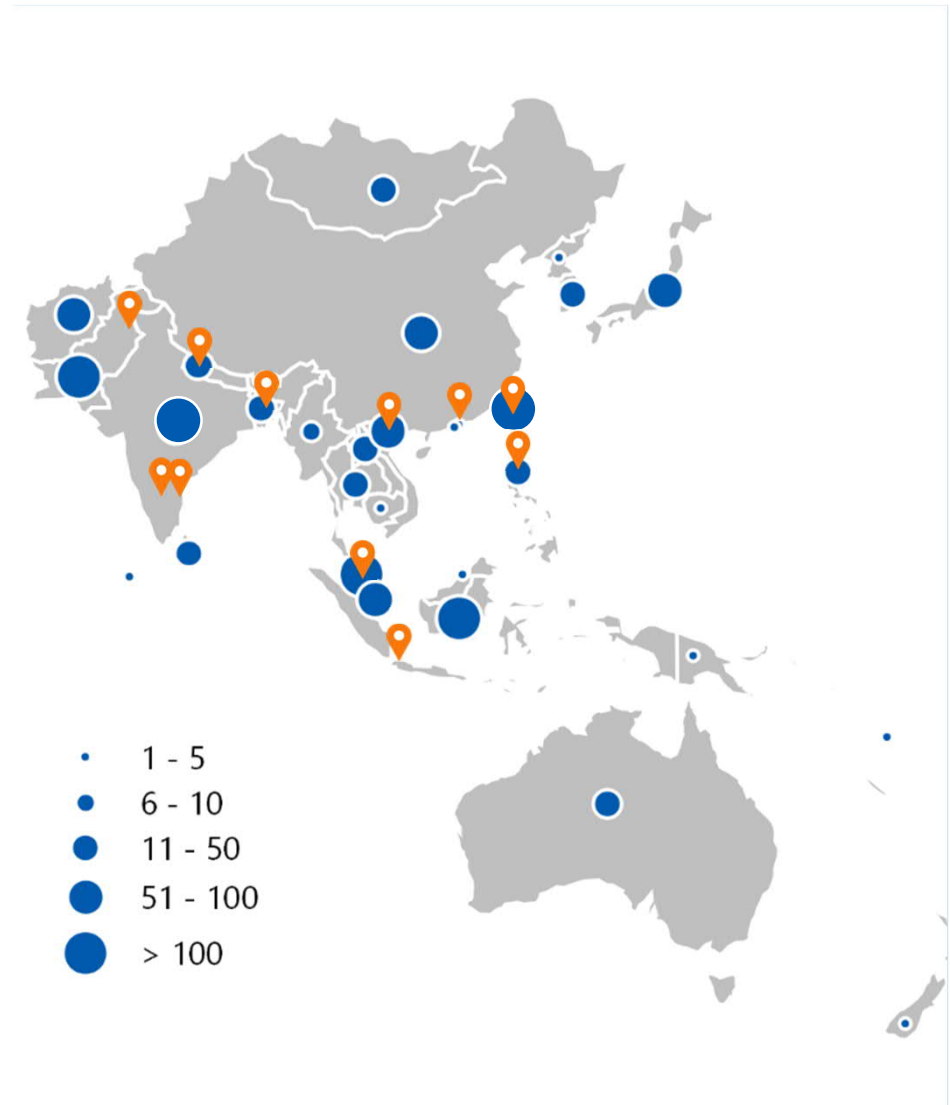
## Experience – Presence

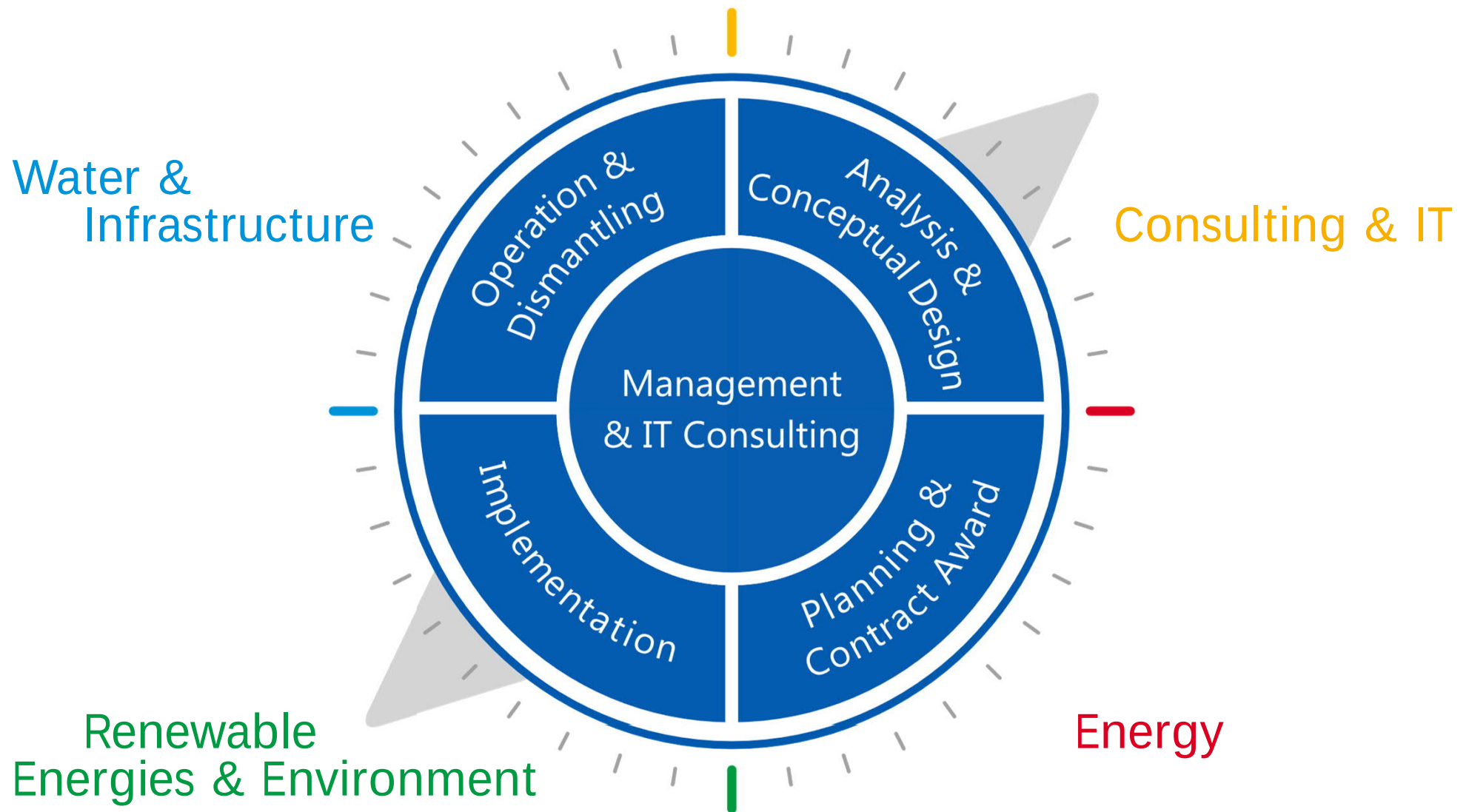
Office locations in Bangladesh, India, Indonesia, Malaysia, Nepal, Pakistan, Taiwan, Vietnam.

To date, the Fichtner Group has handled over 1000 projects in more than 35 countries in the Asia and Pacific region. Our experience encompasses:

- over 130 thermal power generation projects
- over 100 projects in the renewable energies sector – hydropower, solar (PV and CSP), wind, geothermal and bioenergy
- over 70 projects in the sector of power transmission, distribution and power system management
- over 150 projects in the waste management and waste to energy sector
- over 50 projects in the sector of desalination, water supply and sanitation

 Office Locations



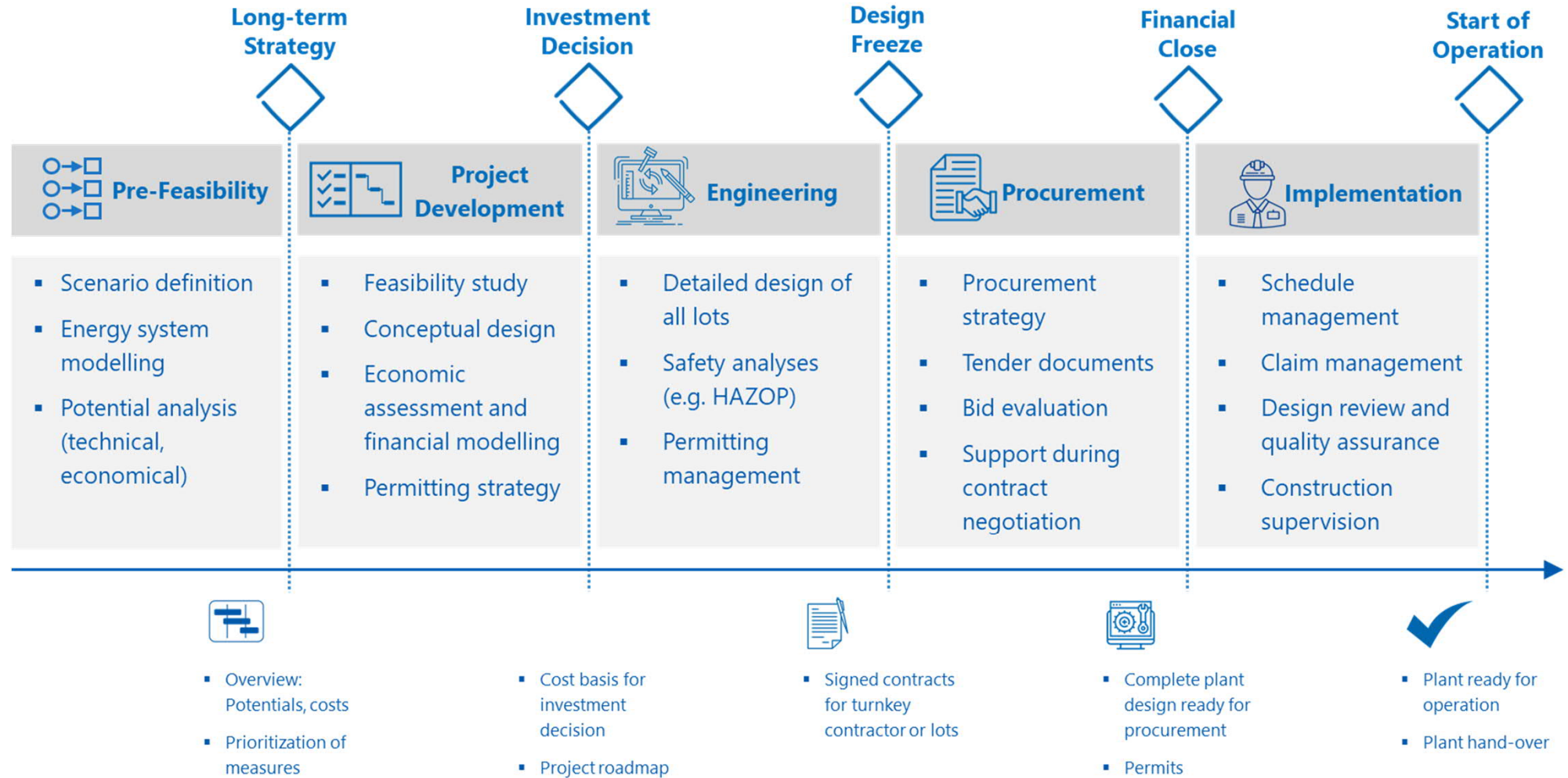


Planning and consulting in all project phases -  
for technically and economically sound solutions



# Fichtner Services

We are capable of providing services along all project phases



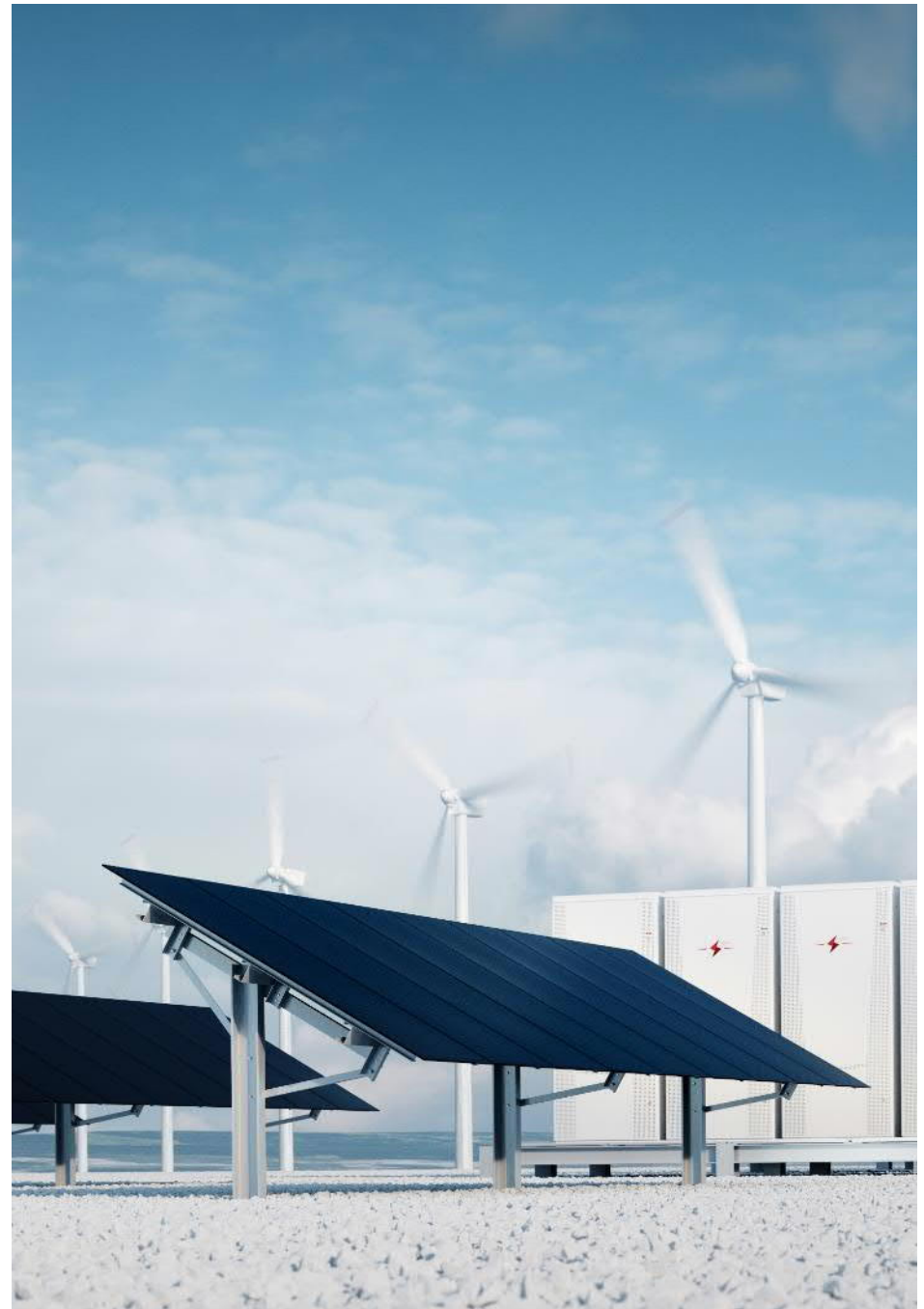
# Hybrid Systems

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## Range of Services

The Fichtner Group can call on a network of highly qualified engineers and consultants in all fields of energy conversion on the basis of hybrid systems, encompassing solar PV, wind, battery storage, fossil power plants, concentrated solar power (CSP), biogas, etc. as well as energy distribution. Our experts are as conversant with the requirements of national and international investors and development banks as they are knowledgeable about local energy supply markets and tariff structures.

- Energy demand and power plant analyses
- Energy yield assessments of solar PV, CSP, wind, etc.
- Techno-financial simulation of hybrid systems as per the VDE PB-014 standard of the German Association for Electrical, Electronic & Information Technologies
- Optimization of component specifications to achieve technical and financial goals
- Feasibility studies
- Acting as owner's engineer and transactional advisor throughout all project phases
- Due diligence audits

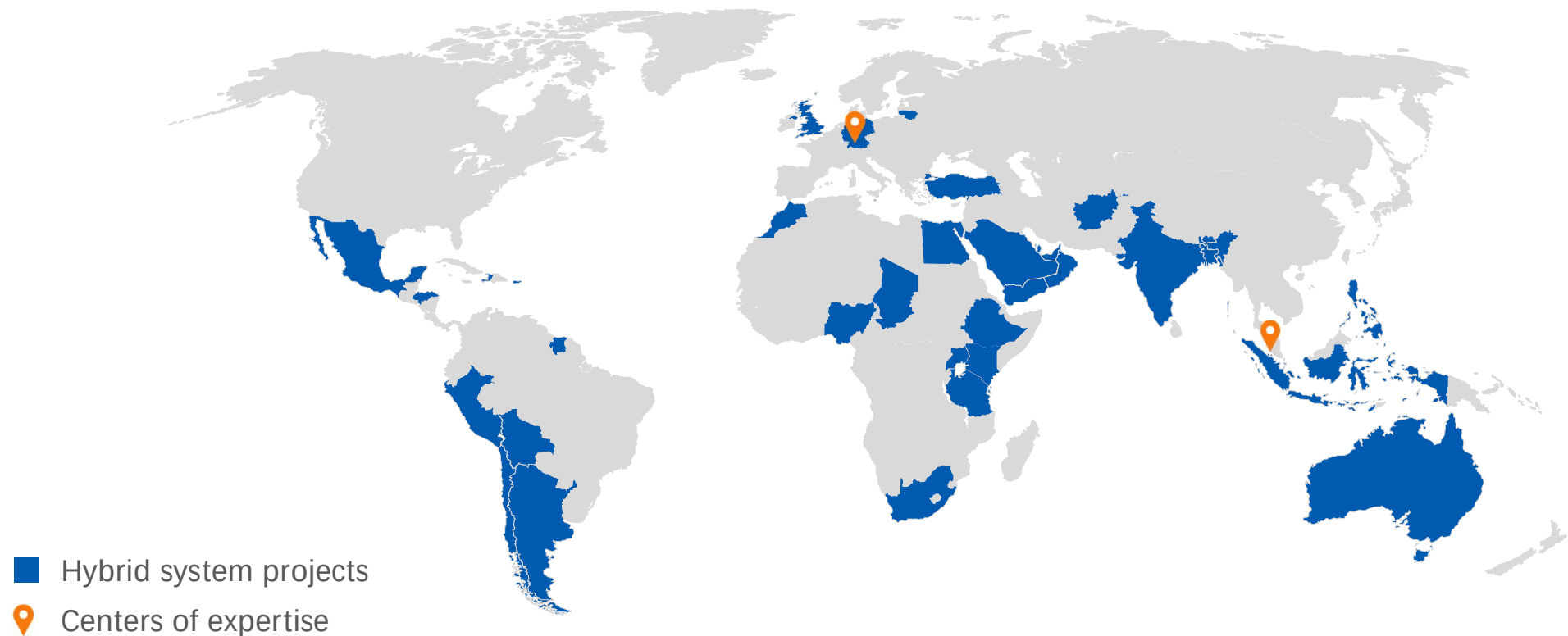


# Hybrid Systems

## Experience – Overview



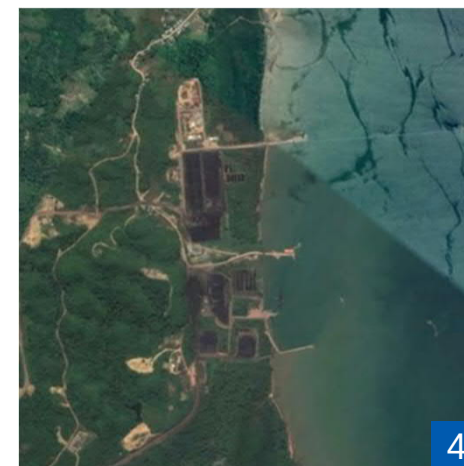
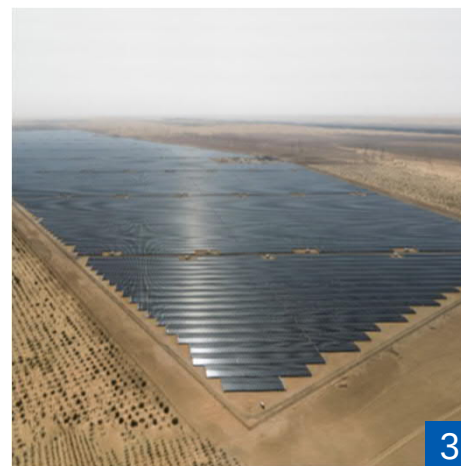
Fichtner has already supported more than 50 hybrid system projects in almost 40 countries and assists its customers as lenders' engineer, owner's engineer or transaction advisor. In addition, we have prepared numerous feasibility studies.





# Hybrid Systems

## Reference Projects (selection)



|   |                                                                                                     |                                                                                                         |                                                                                                                               |
|---|-----------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| 1 | Technical and commercial advisory services for renewable integration at 14 Ma'aden mines, KSA       |  11/2018 – 12/2024  |  Confidential                             |
| 2 | Owner's Engineer for two PV-Diesel-Storage hybrid plants, Surinam                                   |  04/2018 – 12/2021 |  Diesel/PV: 24/2.3 MW<br>Storage: 1.2MWh |
| 3 | Transactional Advisor for PV-Storage hybrid plant, Abu Dhabi                                        |  04/2019 – 02/2020 |  PV: 1,500 MW<br>Storage: 300 MWh        |
| 4 | Feasibility Study for a PV-Hybrid System for a Coal Handling facility in East Kalimantan, Indonesia |  02/2019 – 04/2019 |  Diesel/PV: 26/33 MW<br>Storage: 4 MWh   |

# Hybrid Systems

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## Technical and commercial advisory services for renewable integration at 14 Ma'aden mines

Ma'aden, a mining company in Saudi Arabia, is looking to reduce its fuel domestic consumption in favor of more sustainable energy generation. New alternatives shall be investigated. For this reason, Ma'aden is looking for a highly qualified and experienced technical consultant, who could perform a techno-financial feasibility study for the implementation of PV-Diesel/HFO-Storage hybrid systems for their currently operating as well as new mines and support with the implementation of such hybrid systems.

### Fichtner's services

- Feasibility study for 14 gold, aluminum and phosphate mines
- Draw up of an implementation plan
- Draft a business case as basis for contract award model
- Draw up of tender and contract documents
- Preparation of commercial and technical components of the EPC and BOO contract
- Tendering and contract award
- Construction Supervision



Saudi Arabian Mining Company (Ma'aden)



11/2018 – 12/2024



Confidential

# Hybrid Systems

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## Owner's Engineer for two PV-Diesel-Storage hybrid plants, Surinam

Construction of a 2 MW PV, 1.2 MW/1.2 MWh hybrid plant at Nickerie and a 300 kW, 140 kW/140kWh hybrid plant at Coronie to isolated Diesel off-grid systems, Surinam

### Fichtner's services

- Field survey
- Design review
- Preparation of plant layout, drawings, and complete tender documents
- Bid evaluation
- Contract negotiation
- Supervision of construction, commissioning and acceptance tests
- Overall project oversight and management



NV Energie Bedrijven Suriname (EBS)



04/2018 – 12/2021



Diesel/PV: 24/2.3 MW  
Storage: 1.2 MWh

# Hybrid Systems

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## Technical Transactional Advisor for PV-Storage hybrid plant, Abu Dhabi

The Emirates Water and Electricity Company (EWEC) is implementing its next large scale PV power plant “PV2” as an Independent Power Project as a greenfield solar photovoltaic power plant with a maximum capacity of 1,500 MW (AC), to be located on a flat and vacant site of approximately 20 square kilometres at Al Dhafra, in the Emirate of Abu Dhabi. Due to stability requirements of the grid operator TRANSCO a battery energy storage shall be implemented with a power of 225 MW and a maximum capacity of 300 MWh.

### Fichtner's services

- Design of Battery energy storage to complement the PV power plant
- Drawing up tender documents with technical and commercial conditions
- Bid evaluation and negotiation



Saudi Arabian Mining Company (Ma'aden)



04/2019 – 02/2020



PV: 1,500 MW  
Storage: 300 MWh



# Hybrid Systems

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## Feasibility Study for a PV-Hybrid System for a Coal Handling facility in East Kalimantan

SHIZEN Energy Group is developing a PV-Storage Hybrid power plant for a diesel generation system of a coal mine in the Bengalon area in East-Kalimantan Indonesia. The purpose of the system is to reduce the fuel consumption of the diesel generators and the operating costs. SHIZEN is planning to sell the electricity from the PV plant and needs to make an optimization on the PV-Storage size, technology and layout to reduce curtailments and increase the utilization for the lowest possible generation costs.

### Fichtner's services

- Hybrid system modelling and simulation
- Calculation of levelized cost of electricity and optimization
- Optimum technical and financial specifications and design drawings



SHIZEN Energy Group



02/2019 – 04/2019



Diesel/PV: 26/33 MW  
Storage: 4 MW/4 MWh







## Contact

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Fichtner GmbH & Co. KG

# Hybrid Systems

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## Expansion of a Power Plant on a BOO(T) Basis for a Dairy Company, Saudi Arabia

For increasing power plant capacities to the existing stand-alone diesel generators a new power plant shall be added and put out to tender as a PP or BOO(T) model. For that, conventional and alternative options such as photovoltaic, biomass, organic rankine cycle, diesel generators, gas turbine or combined cycle power plants, hybrid configurations and a grid connection to the regional grid are investigated on technical and economical suitability.

### Fichtner's services

- Feasibility study
- Draw up of an implementation plan
- Draft a business case as basis for contract award model
- Draw up of tender and contract documents
- Preparation of commercial and technical components of the EPC contract
- Tendering and contract award



National Agricultural Development Company  
(NADEC) Riyadh, Saudi Arabia



07/2016 – 12/2017



Diesel/PV/Biogás:  
64/90/6,3 MW,  
Storage: 25 MWh

# Hybrid Systems

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## Drawing up Specifications and Tender Documents, Philippines

Feasibility study and concept design considering the optimum system configuration for numerous generation power plants in off-grid areas.

### Fichtner's services

- Feasibility study
- Preparation of concept design
- Preparation of minimum functional specifications
- Hybrid system optimization with determination of best configuration
- Elaboration of basic design
- Calculation of levelized cost of electricity (LCOE), CAPEX and OPEX
- Preparation of hybrid performance guarantees



# Hybrid Systems

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## Seawater Desalination including Renewable Energy Hybrid Options, Gaza

For a new desalination plant (GCDP) at Gaza the power supply by different power alternatives such as diesel and gas fired captive power or solar (photovoltaic on and off-site or solar thermal off site) and wind power shall be developed.

### Fichtner's services

- Review of basic design and development of concept design
- Analysis of solar power potentials at GCDP on-site (roof top) and off-site (PV fields outside the project site), decentralized PV on roof tops or agricultural land, or a large solar thermal power plant outside the project site
- Analysis of other renewable options (wind, biomass, geothermal)
- Modeling and optimization of a hybrid-power system including solar energy using the "Fichtner Hybrid Configurator"



Palestine Water Authority



01/2014 – 01/2016



Diesel/PV/wind power:  
25/14/4 MW



# Hybrid Systems

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## Technical Due Diligence of a 50 MW PV-Battery Hybrid Power Plant, Puerto Rico

The client is constructing a 58 MWp PV plant connecting to the PREPA electrical grid at Mora Transmission Line switchyard. The project includes a 20 MW battery installation. The PV installation is split into the two areas – Oriana Sites I and II. The project design also involves relocation of the existing PREPA lines.

### Fichtner's services

- Third-party assessment of the performance of the 'procure and construct' contractors
- Monitoring and reporting on project progress and risks to lender representatives during project construction.



Oriana Energy LLC, Puerto Rico



12/2015 – 06/2017



Fixed-tilt PV: 58 MW DC,  
58 MW AC; storage: 20 MW

# Hybrid Systems

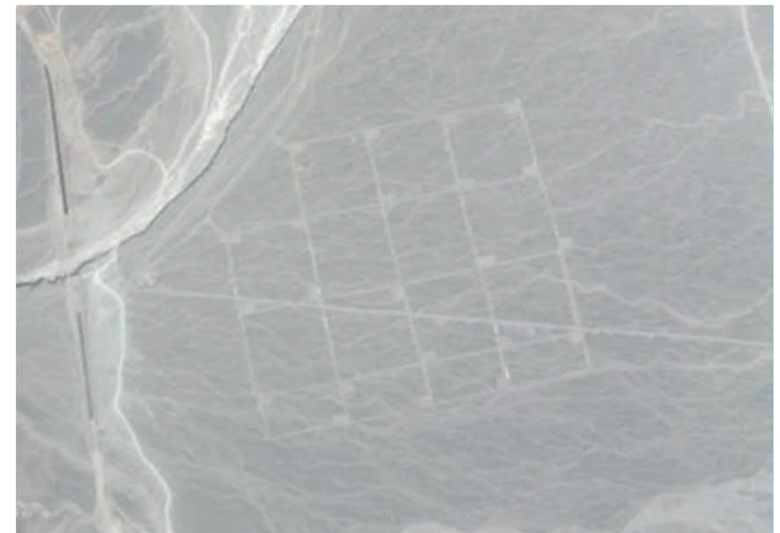
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## Review of tying in Options for Renewable Energies into a Potash Salt Mine, Ethiopia

For the development of a new potash salt mine in Ethiopia the power supply through diesel generators was investigated due to the absence of an electrical grid. As a further option, Fichtner investigated the tie-in of renewable energies to use an off-grid power supply as hybrid system

### Fichtner's services

- High level investigation of renewable energy supply options, either as a stand –alone solution or as hybrid solution.
- Investigation of the general economic viability of various renewable power supply options



Dead Sea Works Ltd., Ethiopia



06/2015 – 10/2015



Confidential

# Hybrid Systems

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## Application of Renewable Energies for a Mine in the Andes, Chile

For the off-grid energy supply of a mine in the Andes in Chile, the client has to include renewable energy sources. Fichtner undertook a study on the efficient utilization of renewable energies for the future power supply concept of the mine.

### Fichtner's services

- Technology analysis of wind, photovoltaic and concentrated solar power
- Analysis of the battery and storage systems
- Estimation of the potential value of those renewable energies to the existing conventional power system
- Evaluation of the potential benefits combining wind and photovoltaic technologies
- Indication of the contribution to the electrical matrix and existing market trends



Minera Escondia Ltda. Chile



03/2015 – 07/2015



Confidential

# Hybrid Systems

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## Support of Diesel Generators through Roof Top Photovoltaic Plants (40MW), Haiti

The client is developing various PV-Diesel hybrid projects in Haiti. For that, at around 50 different locations, the existing diesel generators shall be supported by small roof top photovoltaic systems with a total capacity of 40MWp for industrial and commercial use. The new system application will be supported through the installation of a Fuel-Save-Controller.

### Fichtner's services

- Technical due diligence for implementing PV-Diesel hybrid micro grids
- Monitoring of the project implementation (mostly roof-top installations)



Financing Investors / Development Bank, Haiti



11/2014 – 01/2016



50 sites Ave. generation  
capacity 200 – 2000kW

# Hybrid Systems

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## Technology Assessment and Power System Planning, Maldives

For reducing dependency on imported fossil fuels for power generation the use of renewable energies and the adoption of energy efficiency measures in an island community called Thinadhoo, Maldives was analyzed.

### Fichtner's services

- Technology assessment of photovoltaic and waste-to-energy systems
- Review of PV-Diesel/Gas Hybrid Systems as possible options for the Maldives Islands
- Updating the Power System Expansion Plan for Thinadhoo to 2025
- Training and capacity building
- Owner's engineering services during implementation of the EPC contract for the photovoltaic investment



Ministry of Environment and Energy, Republic  
of Maldives



06/2013 – 07/2014



Confidential



# Hybrid Systems

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## Hybrid Power Plant for an Algae Breeding Station Hatchery, Peru

The client is developing a hybrid power plant at an algae breeding station at Marcona, Peru. Fichtner reviewed the optimization of the hybrid system, including photovoltaic and wind power, diesel generator and electrical storage.

### Fichtner's services

- Analysis of wind and PV potential (load curve generation)
- Optimization of hybrid power plant configuration
- Basic design for hybrid power plant
- Drawing up a bill of quantities for materials with cost estimation
- Hybrid power plant technology: PV/Wind/Diesel / Electricity with an average consumer load of 100kW



Enel Green Power S.p.A.



05/2014 – 07/2014



Confidential

# Hybrid Systems

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## Grid-connected PV plant / Off-grid PV-Battery-Diesel Hybrid Plant, Bangladesh

Construction of a 7.4 MW grid connected photovoltaic plant at Kaptai and of a 4.2 MW isolated PV-Diesel off-grid system to supply power on Hatiya Island, Bangladesh.

### Fichtner's services

- Field survey
- Design review
- Preparation of plant layout, drawings, and complete tender documents
- Bid evaluation
- Contract negotiation
- Supervision of construction, commissioning and acceptance tests
- Operation monitoring during warranty period
- Overall project oversight and management



Bangladesh Power Development Board (BPDB)  
Dhaka, Bangladesh



05/2013 – 08/2016



Capacities: 7.4 MW PV  
4.2 MW PV-diesel

# Hybrid Systems

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## Integration of Photovoltaic-Diesel Hybrid Plants in island networks, Chad / Tanzania

Study on the technical aspects for configurations of hybrid systems in Tanzania and Chad for integration of photovoltaic power with other sources of electricity.

### Fichtner's services

- Financial and technical analysis for integrating PV in off-grid diesel energy systems compared to grid connected energy systems
- Scenarios and system configurations for small and large island networks of 500kW (residential area) and 5MW (industrial consumers)
- Calculation of system dynamics
- Development of a simplified cash flow model



IFC International Finance Corp.



05/2013 – 08/2013



Confidential

# Hybrid Systems

## Analysis of Renewable Energies Market - 5MW Photovoltaic Hybrid Plant, Bahrain

Bahrain aims to foster a socio-economic development by providing a green, reliable and resilient energy system that is environmental friendly. A 5 MW Hybrid plant based on PV and wind shall be erected.

### Fichtner's services

- Assessment of renewable energy potential of Bahrain
- Implementation of a pilot power plant to assess the performance of wind and PV
- Planning and design (feasibility study, conceptual design, financing options, O&M staff training)
- Tendering (development of tender strategy, pre-qualification, evaluation and contract negotiations)
- Contract management including review and approval of design, site supervision, claim management, commissioning



EWA Electricity and Water Authority, Bahrain



04/2011 – 10/2014



PV: 3 MW  
Wind: 2 MW

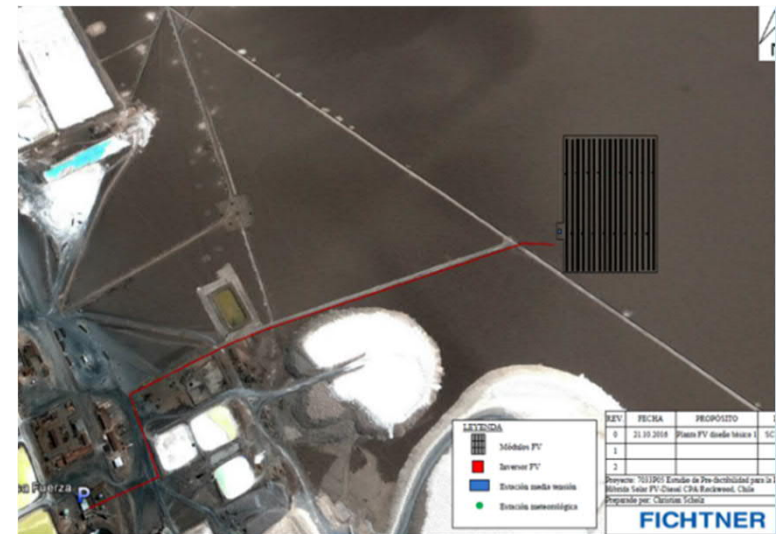
# Hybrid Systems

## Feasibility Study for a PV-Diesel-Battery Hybrid Power Plant in Rockwood, Chile

Rockwood Lithium Ltda. operates a mine with a power consumption of 1.6 MW. Since the power supply is covered by Diesel the potential for a hybrid system is investigated, including the best proportion of photovoltaic and Diesel power.

### Fichtner's services

- Calculation of levelized cost of electricity
- Preparation of hybrid system basic design for tender
- Determine the optimal hybrid configuration with the greatest economic benefit



Banco Interamericano de Desarrollo (BID/IDB)  
Representación en Chile



07/2016 – 12/2016



Diesel/PV: 3,6/2 MW,  
Storage: 1 MW/1MWh



# Hybrid Systems

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## Technical assistance for Mwambwa Hydropower-PV Hybrid Power Plant, Zambia

Pre-feasibility study for evaluating the potential of a hydropower-photovoltaic hybrid power plant at four different location of the Mwambwa River, Zambia.

### Fichtner's services

- Pre-feasibility study
- Yield and cost estimations for hydropower and photovoltaic
- Defining and optimizing the best possible combination of the hybrid system



EleQtra Ltd., United Kingdom



10/2017 – 12/2017



Confidential

# Hybrid Systems

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## Feasibility Study on implementing Photovoltaic-Battery Hybrid Power Plant, Bolivia

Feasibility study for eight isolated photovoltaic-battery hybrid systems in the Bolivian Amazon Basin to reduce or eliminate the dependence on diesel-generated power.

### Fichtner's services

- Feasibility studies
- Project engineering / technical pre-design of hybrid system alternatives
- Selection of the technological alternative of minimum cost
- Analysis of unit prices and budget estimates
- General, special and environmental technical specifications
- Financial and socioeconomic evaluation
- Classification and qualification of the operator
- Rural electrification environmental management



Ministerio de Energías del Estado Plurinacional  
de Bolivia



12/2016 – 10/2017



8 sites with PV from  
100 kW to 2 MW

# Hybrid Systems

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## Feasibility Study for a PV-Hybrid System – NIMR Water treatment Plant, Oman

Bauer NIMR LLC. operates a water treatment plant with a power consumption of 600 kW. Since the power supply is covered by Diesel the potential for a hybrid system has been investigated, including the best proportion of photovoltaic, Diesel power and electrical storage.

### Fichtner's services

- Hybrid system modelling and simulation
- Calculation of levelized cost of electricity and optimization
- Optimum technical and financial design drawings



Bauer NIMR LLC



02/2019 – 04/2019



Diesel/PV: 765 kW/550 kWp;  
Storage: 300 kW/800 kWh