



**AMERICAN
ELECTRIC
POWER**

BOUNDLESS ENERGYSM

BOUNDLESS ENERGYSM



Innovation Overview and Advanced Technology Focus Areas
Ram Sastry, VP – Innovation and Technology
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AEP IS GLOBALLY LOOKING FOR NEW TECHNOLOGIES



Nick Akins, Chairman, President and CEO recently said:

"I am confident in our ability to transform our industry for the benefit of the communities we serve. AEP is globally searching for, and validating innovative, advanced technologies, especially to integrate into the distribution grid of the future, for all of our customers and for our operations. Our electrification activities need to improve the lives of all members of society."



THE GRID OF THE FUTURE



Decentralized

Intelligent devices from substations to customers' homes and premises – Industrial Internet of Things



Digitalized

Network services across multiple platforms providing customers with greater control over energy products and services



Decarbonized

Cleaner, greener more sustainable energy options

AEP AREAS OF INTEREST EXAMPLES: Platforms (P), E-Mobility (E) and Resiliency (R)

- P/R-Distributed Energy Resource Management Systems (DERMS)
- P/E-Mobility – EV Fleet Management and Optimization
- P/E-Mobility – Vehicle to Grid, etc. (V2x) applications (Grid and Home)
- P/E/R-Machine Learning (ML)/Artificial Intelligence (AI) Use Cases for Energy Management for Commercial Customers
- P/R-ML/AI Use Case for Asset Management (aka Predictive Analytics)
- P/R-ML/AI Use Case for sensor data (on grid and at customer premise)
- Resiliency as a service
- Reliability as a service
- P-UAS/Image Processing/Work Management Integration
- P-Blockchain Use Case – Customer Data Management and Digital ID
- P-Blockchain Use Case – Transactive Systems
- P/R-Micro and nano grids
- R-Residential distributed solar plus storage
- P/R-second life storage

Seeking deployable opportunities that are looking 2 – 5 years into the future



START-UP PITCH DECK QUESTIONS TO ANSWER ABOUT YOUR TECHNOLOGY

1. What is the challenge your technology can solve for AEP?
2. What is the solution that your technology provides?
3. Describe a pilot with the minimum, fastest to complete activities that would demonstrate its benefits to AEP and its customers
4. What would you need from AEP to have a successful pilot?
5. What would be the approximate cost of your pilot?
6. What would be the milestones and duration of your pilot?





FREE ELECTRONS 2020

Introduction to AusNet Services for start-ups

OUR BRANDS



Owns, operates and controls energy delivery infrastructure for 6.5 million Victorians.

Recognised as national leaders in efficiency and innovation.



Energy and infrastructure services for businesses, government, and communities.

Development and deployment of world leading solutions, connecting you to the new energy future.

Mondo is a commercial, unregulated subsidiary of AusNet Services.



WE ARE LOOKING FOR

Ideas, products and solutions that help drive digital transformation.

New ways of operating that improve performance and quality of service for our customers, employees, suppliers and partners.

WE ARE INTERESTED IN

Improving Safety

For our people and our customers

Distributed Energy Resources

SME and Industrial DER, Microgrid, Grid integration of DER, Network Demand & DER Generation forecasting, DER marketplace

Demand Response & Demand Management

Energy Aggregation & Orchestration

Data Driven Intelligence / Insights

Using smart meter and asset data for Risk based and predictive maintenance, Predictive outage management, Network modeling, HV/LV modeling & Spatial analytics

Digital Asset Models

Using satellite remote sensing data, aerial/mobile LiDAR and image data for Automated defect identification, Predictive vegetation growth & Digital 3D design and modelling

Enhanced Customer & Employee experience

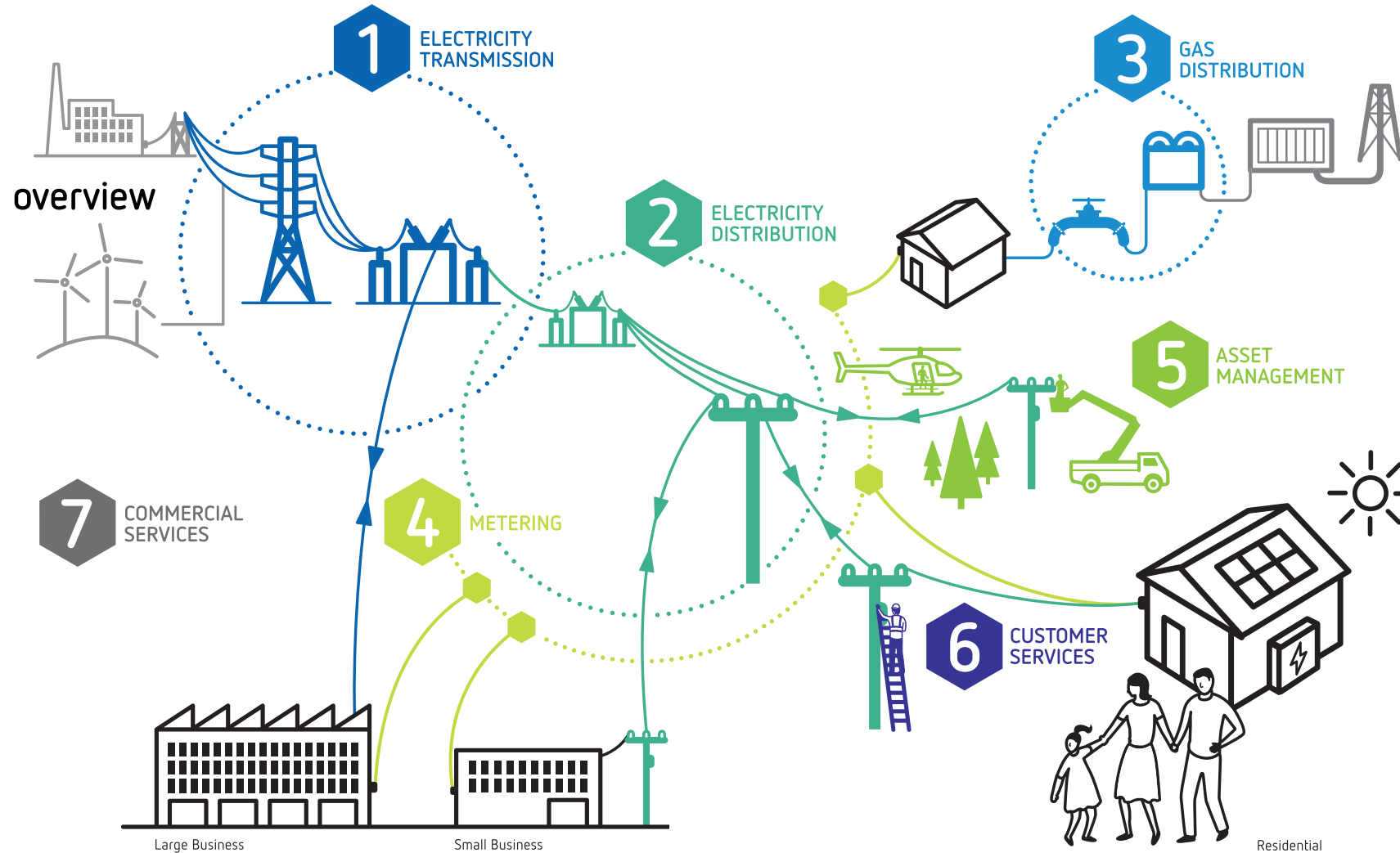
Improving our end to end service provision for our customers.

Cyber Security

Something Amazing

An application in an area of interest or a new or disruptive business model that we can't go past - feel free to convince us

Who we are and what we do



1 ELECTRICITY TRANSMISSION

Moves electricity long distances from multiple generation sources at high voltages along transmission powerlines and towers into the distribution network.

2 ELECTRICITY DISTRIBUTION

Converts and delivers electricity at lower voltages into homes and businesses.

3 GAS DISTRIBUTION

Converts gas from high to lower pressures for delivery into homes and businesses.

4 METERING

Collecting and analysing consumption data for billing and network operation purposes.

5 ASSET MANAGEMENT

The inspection and maintenance/enhancement of gas and electricity assets, including vegetation management.

6 CUSTOMER SERVICES

Supporting our customers to enhance their electricity and gas network experience.

7 COMMERCIAL SERVICES

Providing infrastructure assets and services, and energy solutions to commercial customers.

WHY US

Working with us will give you access to



Electricity distribution

50,000km+
network

700,000+
Customers

100% Smart
Meters
homes and businesses

Electricity transmission

6,000km+
transmission lines

13,000+
transmission towers

Gas distribution

11,000km
of network

600,000+
Customers

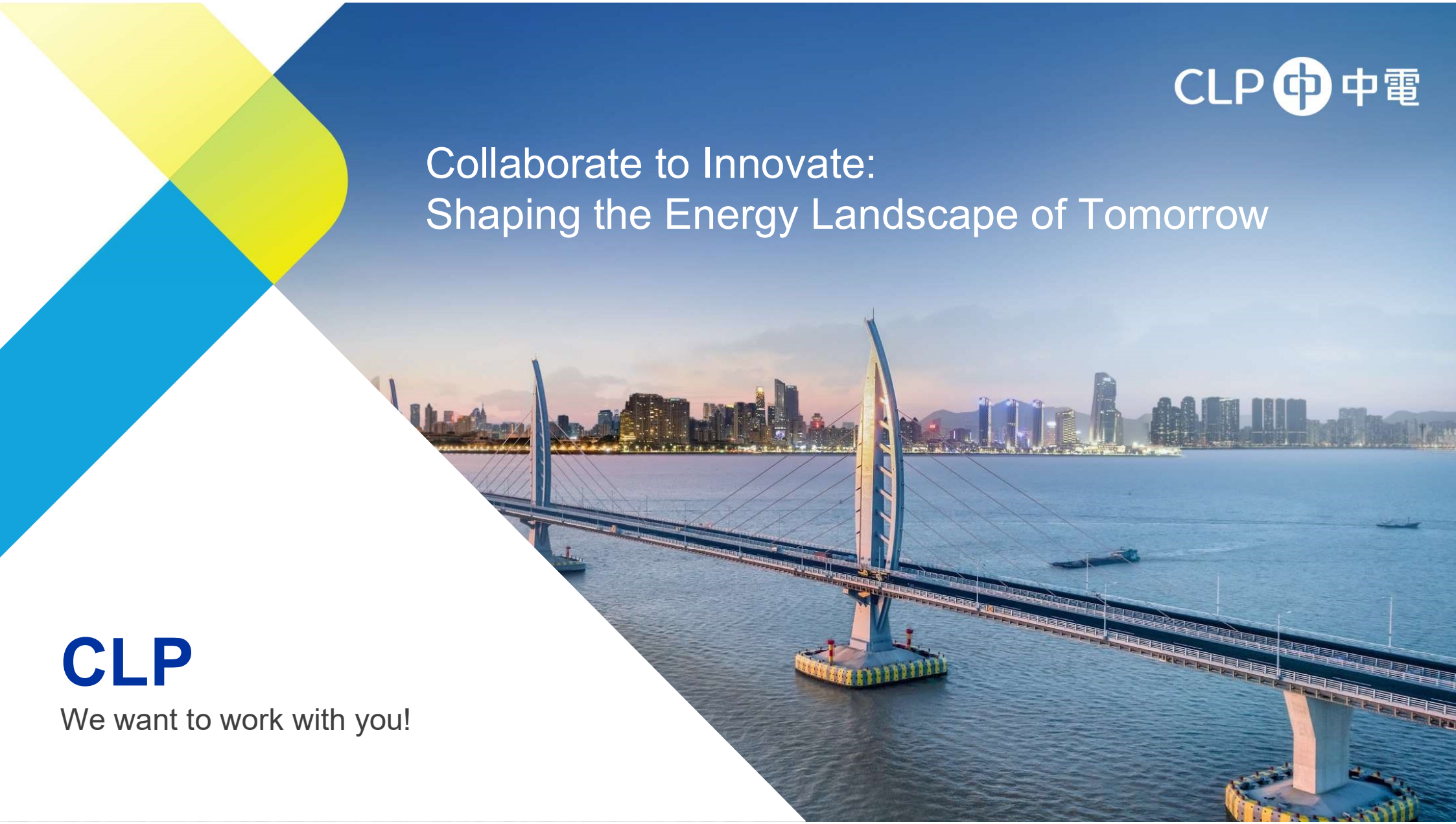


*Come and work with
us down under*

Collaborate to Innovate:
Shaping the Energy Landscape of Tomorrow

CLP

We want to work with you!



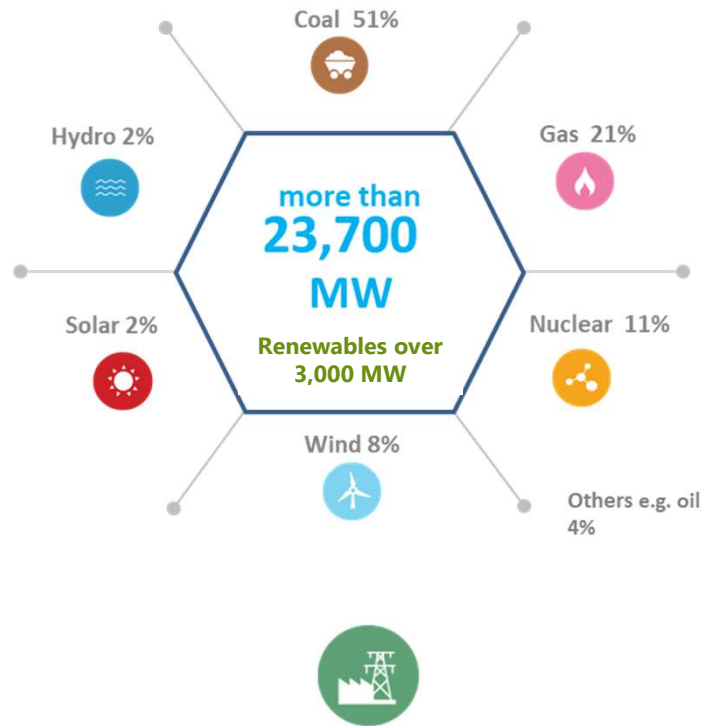
CLP is a leading utility in APAC

APAC operations



Revenue in 2018
~US\$ 12 billion

Generation and Transmission



Over 15,800 km transmission lines

Retailer and Services

Over 5.1 million Customers

EV charging network

Smart Energy Connect
Smart Energy Services

Smart CITY and GRID

CLP Businesses in APAC

CLP Power Hong Kong



Generation



Transmission & Distribution



Over 2.6 million customers



New Energy Services

CLPe Solutions

- Power engineering
- Infrastructure
- Facilities management
- Consulting
- Smart energy services
- DER



Platform that offers digital energy management solutions to save energy, money and time:

- Sustainability
- Energy cost saving
- Wellness
- Security
- Connectivity
- Productivity



EV charging infrastructure

CLP Businesses in APAC



Mainland China

Generation: One of the largest external independent power producers with a focus on clean and low-carbon energy, including nuclear and renewables

Developer of Incremental Distribution Networks (IDN) and energy services



India

Generation: Operate broad generation portfolio covering coal, gas and wind and solar energy.

CLP is one of the largest foreign players in the Indian power industry



Southeast Asia and Taiwan

Generation: Investments in a solar project in Thailand and a coal-based generation plant in Taiwan



Australia

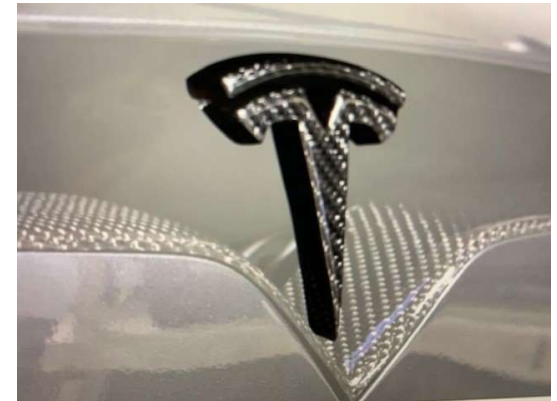
Gentailer: Provide gas and electricity to 2.50 customer accounts and owns & operates a portfolio of generation assets, including coal, gas, wind power and battery storage

Energy Solutions: CLP is actively offering innovative energy solutions focused on *C&I and industrial parks*, including:

- Microgrid solutions
- PPA
- EV charging
- Battery
- DER
- Smart Energy Services

Why does CLP work with Start-ups?

To provide new **digital, connected, smart** and **low carbon** products and services to our customers and **prepare** our assets for the future.



From **producing electricity** to **offering customer centric energy related services**.
Energy is one of the last industries to be disrupted

Digitalisation
Decarbonisation
Decentralisation
Democratisation
Electrification

Competition from **disruptive players** and **convergence of industries**

Why Work With CLP?



Revenues → Route to Market within CLP and to our Customers:

Access to APAC Markets, 5 mln+ customers, World class brand



Domain and Marketing Expertise:

We have 118 years of experience and a Diverse Portfolio for you to test solutions



We really make it easy to work with us:

Simple agreement and a process to quickly pilot & deploy your solution



We have outstanding People:

Diverse range of skills, all committed to the future of energy



What are we looking for?



Customer Solutions

Our customers need solutions that increase **insights, efficiency, sustainability, connectivity, safety, wellbeing** and **productivity**. We are in the process of rolling out smart meters to all our Hong Kong customers.

- Smart Home and Solutions using Smart Meter data
- Smart Office – comfort, services offerings
- Smart Buildings – retro-commissioning, energy efficiency, BEMS
- Facility Management – productivity
- Green Energy - PPA



Distributed Generation and Demand

Flexible generation and demand are playing a large role in the future of the grid.

- Integration of customer solutions with grid solutions
- Demand management solutions



Smart City Solutions

Industries are converging and CLP as infrastructure provider has an important role in the city of the future. How can you help our citizens and public services.

- Data optimization and sharing tools
- Energy sharing platforms
- Data centre solutions
- Public lighting, safety, transport, healthcare, education



Smart Grid and Distribution

The future of networks is connected and decentralized. We are preparing our grid and offering microgrid solutions to end customers

- Microgrid solutions for HK, China, Thailand and India
- Distributed Energy Resources
- Demand Management for Hong Kong
- Integration of renewables
- Future proofing of grid operations and business model



Transportation and Mobility

The number of EV's is increasing and hence creating an impact on CLPs grid in Hong Kong. CLP also owns a charging network

- EV solutions for grid operator
- EV Charging platform
- Fleet management (busses, trucks, taxis etc)



Operational efficiency

Improving the resource allocation of our current operations.

- Wind farm analytics – fault predictions & (price) forecasting
- Predictive maintenance for critical assets in our infrastructure
- Increase insights in our customer base



Moonshot Ideas

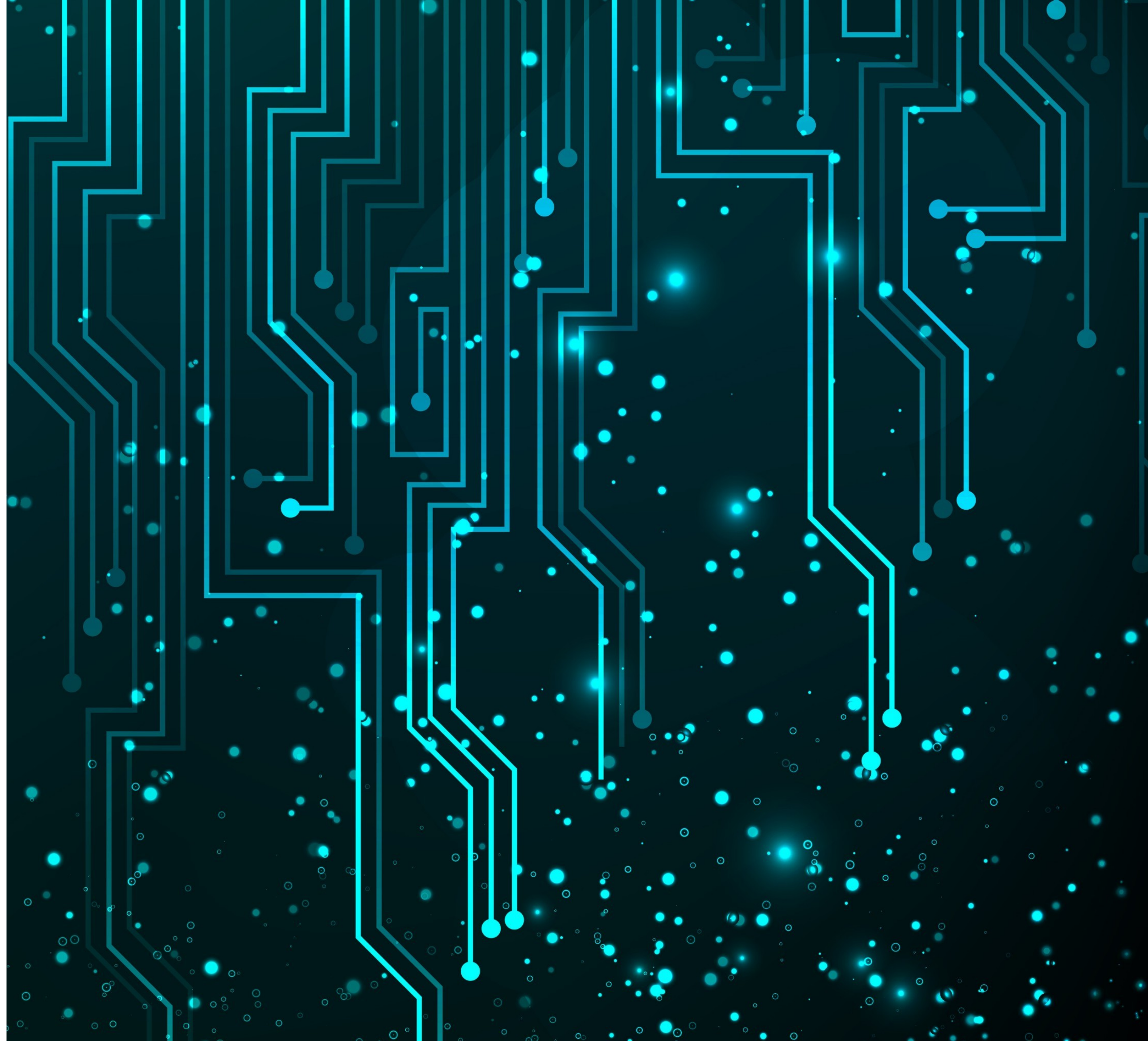
Surprise and convince us! How can we not have thought about this and why should CLP do this! We are all ears!

DEWA

Dubai Electricity & Water Authority



هيئة كهرباء ومياه دبي
Dubai Electricity & Water Authority



SUPPORT FROM OUR LEADER

H.H Sheikh Mohammed bin Rashid Al Maktoum Directed the Nation to Focus on Innovation at a Global Level and Become One of the Most Innovative Nation

“The UAE is already the most innovative Arab nation. Our target is to be amongst the most innovative nations in the world”

His Highness Sheikh Mohammed bin Rashid Al Maktoum
Vice President ad Prime Minister of the UAE and ruler of Dubai



SUPPORT FROM MD&CEO OF DEWA

H.E. opened the doors for all DEWA employees to use their innovative minds to lead DEWA toward its vision

“The stage is yours to prove your capabilities, improve your skills and enhance your knowledge to help DEWA consolidate its leadership at the global level. You can achieve this in the highly motivating environment that DEWA provides to encourage innovation and success, so that excellence becomes a lifestyle and a way of thinking”

His Excellency Saeed Al Tayer

MD&CEO of DEWA

DEWA's Vision

A Globally Leading Sustainable Innovative Corporation





DEWA AREAs of FOCUS

DEWA is aligned with many Agendas, Strategies, Government Plans and Visions of Our Great Leaders

To be a Digital Utility and Lead the Way of Digital Transformation



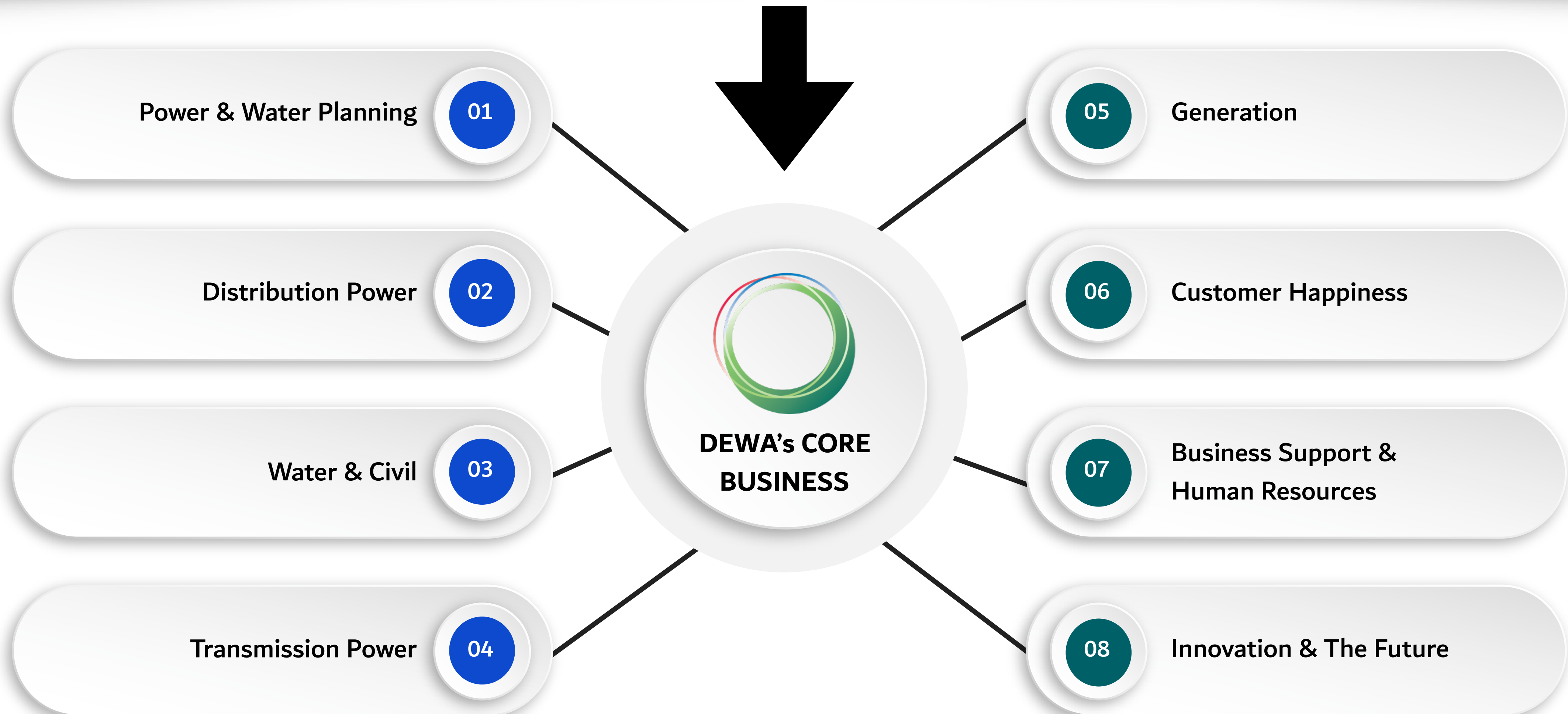
- Global Focus
- UAE Focus
- Dubai Focus



SOLUTION REQUIREMENTS

FREE ELECTRONS: THE GLOBAL ENERGY ACCELERATOR

“Accelerate digital transformation in the energy industry through disruptive technologies that are not limited to Quantum Computing, and can include Artificial Intelligence (AI), Blockchain, Automation, Robotic Process Automation (RPA), Internet of Things (IoT), Augmented Reality and others”





DIGITAL TRANSFORMATION IN DEWA



-END-

THANK YOU



هيئة كهرباء ومياه دبي
Dubai Electricity & Water Authority



EDP Innovation



EDP GROUP OVERVIEW



CONSOLIDATED 2018

Clients: ~11Mn

EBITDA: € 3.3 Bn

Generation cap: 27.1GW

EDP PORTUGAL

32% of EBITDA*

#1 Producer, distributor and trader in Portugal

EDP RENEWABLES

WIND & SOLAR POWER

39% of EBITDA*

#4 player in wind power worldwide

EDP BRAZIL

20% of EBITDA*

#4 private wholesale market player
#5 private power generation

EDP SPAIN

9% of EBITDA*

2 in gas retail



● Gen., Dist., Retail + Renewables

● Renewables

● Other Business

* Percentage of recurrent EBITDA

EDP INNOVATION PRIORITIES

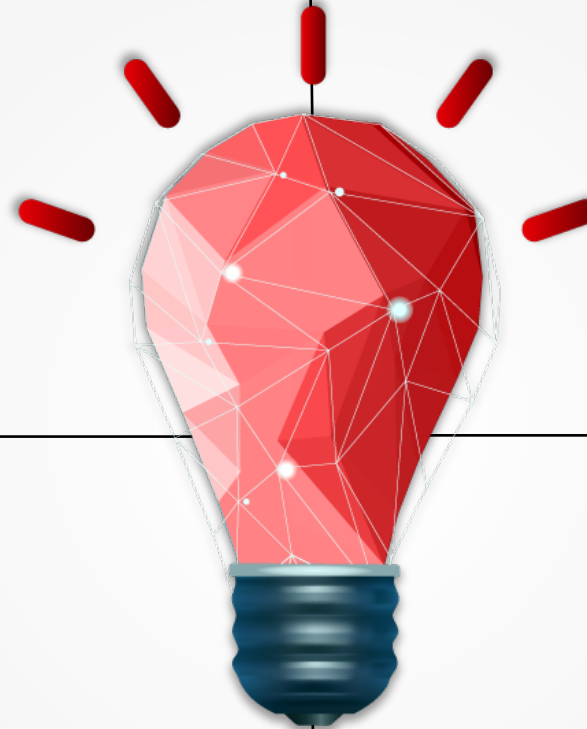
SMARTER GRIDS

Smart Grids Infrastructure
Energy Distribution Management
Demand Response
Energy Aggregation
Micro-Grids



CLEANER ENERGY

Centralized Renewable Energy
Assets Monitoring and Sensing
Preventive / Predictive analytics
O&M



CLIENT-FOCUSED SOLUTIONS

Energy Efficiency
Mobility
Connected/Smart Homes
Distributed Solar
New services / new offers



DATA LEAP / DIGITAL

Big Data and Advanced Analytics
IoT
Cybersecurity
Artificial Intelligence
Augmented Reality
Blockchain
Quantum Computing



STORAGE AND FLEXIBILITY

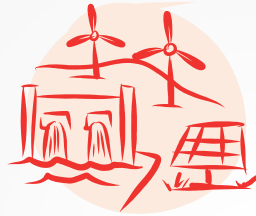
Flexibility and aggregation for demand response
Preventive / Predictive analytics for energy storage technologies
Storage behind-the-meter
Utility-scale storage

OUR 2030 VISION

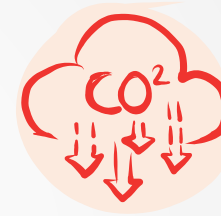
Leading the energy transition to create superior value



Decarbonization



**>90%
renewables
generation**



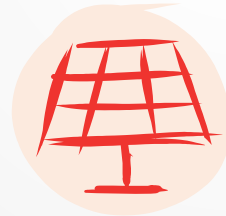
**Reduce 90%
specific
emissions** (vs 2005
levels)



**Become
coal-free**



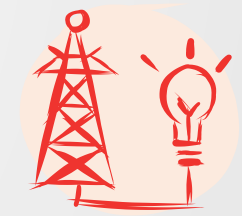
Digitalization



**>4 Mn decentralized
solar PV panels
installed**



**>1 Mn clients
with e-mobility
solutions**



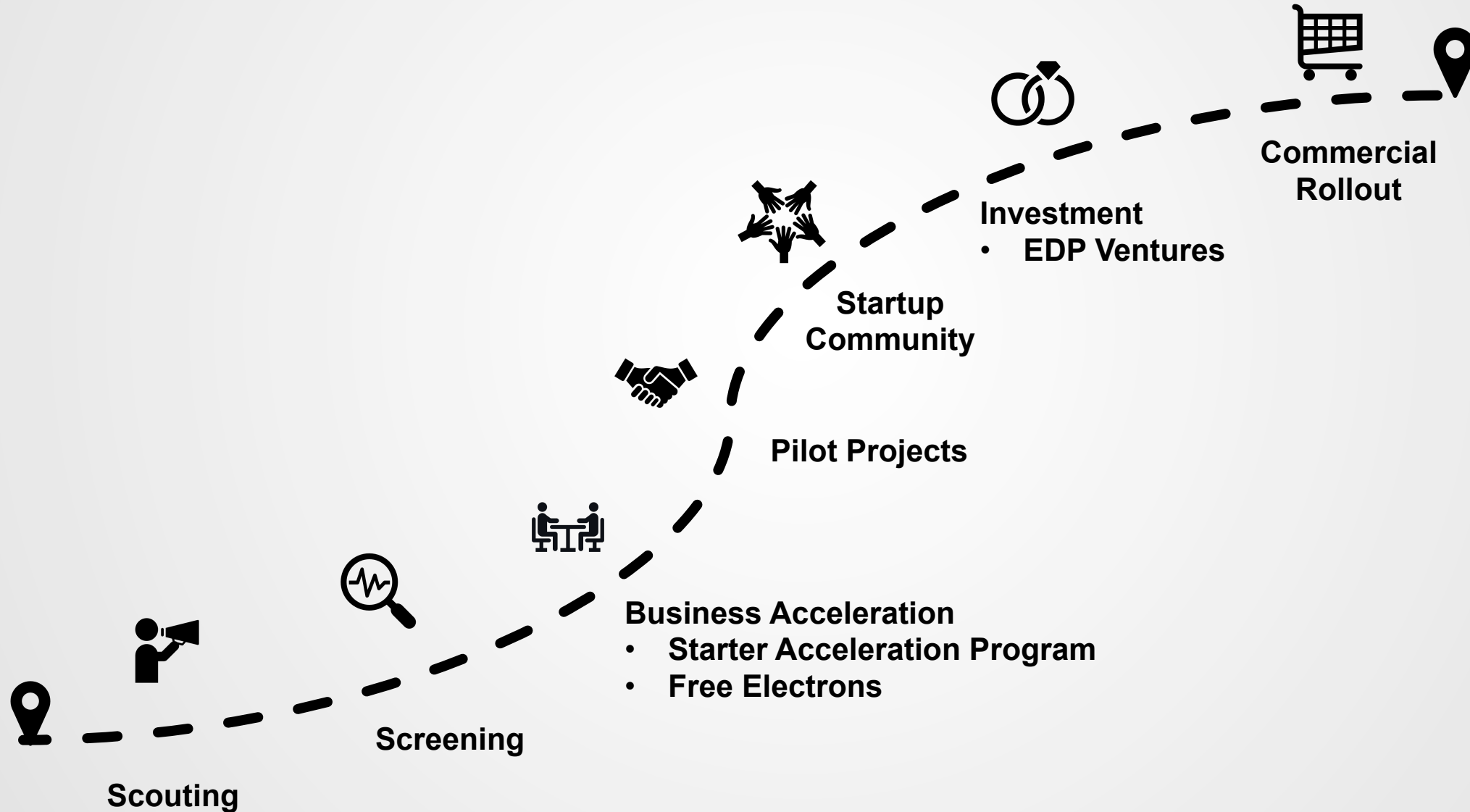
**100% smart
grids**
(in Iberia)



Decentralization

EDP's **STARTUP ROUTE**

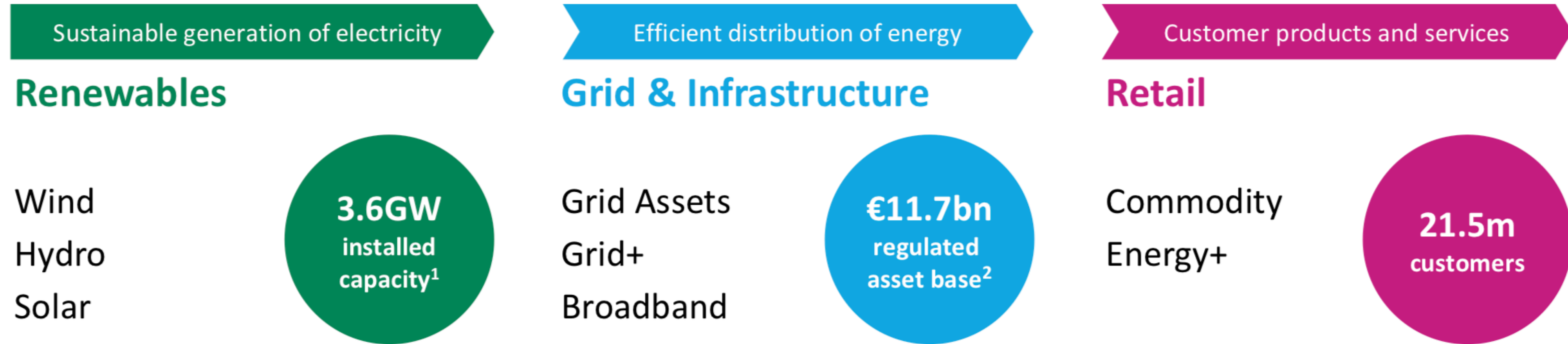
How we work with startups



innogy is a stable business with a platform for growth



innogy is active along the energy value chain in three divisions



- 📍 2019 targeted net investments of ~€2.5bn³
- 📍 Targeted payout ratio of 70-80% of adjusted net income

- 📍 Market cap of around €23.7bn (as of 7 Aug 2019)
- 📍 40,522 employees (as of 30 Jun 2019)

Note: Rounding differences may occur.

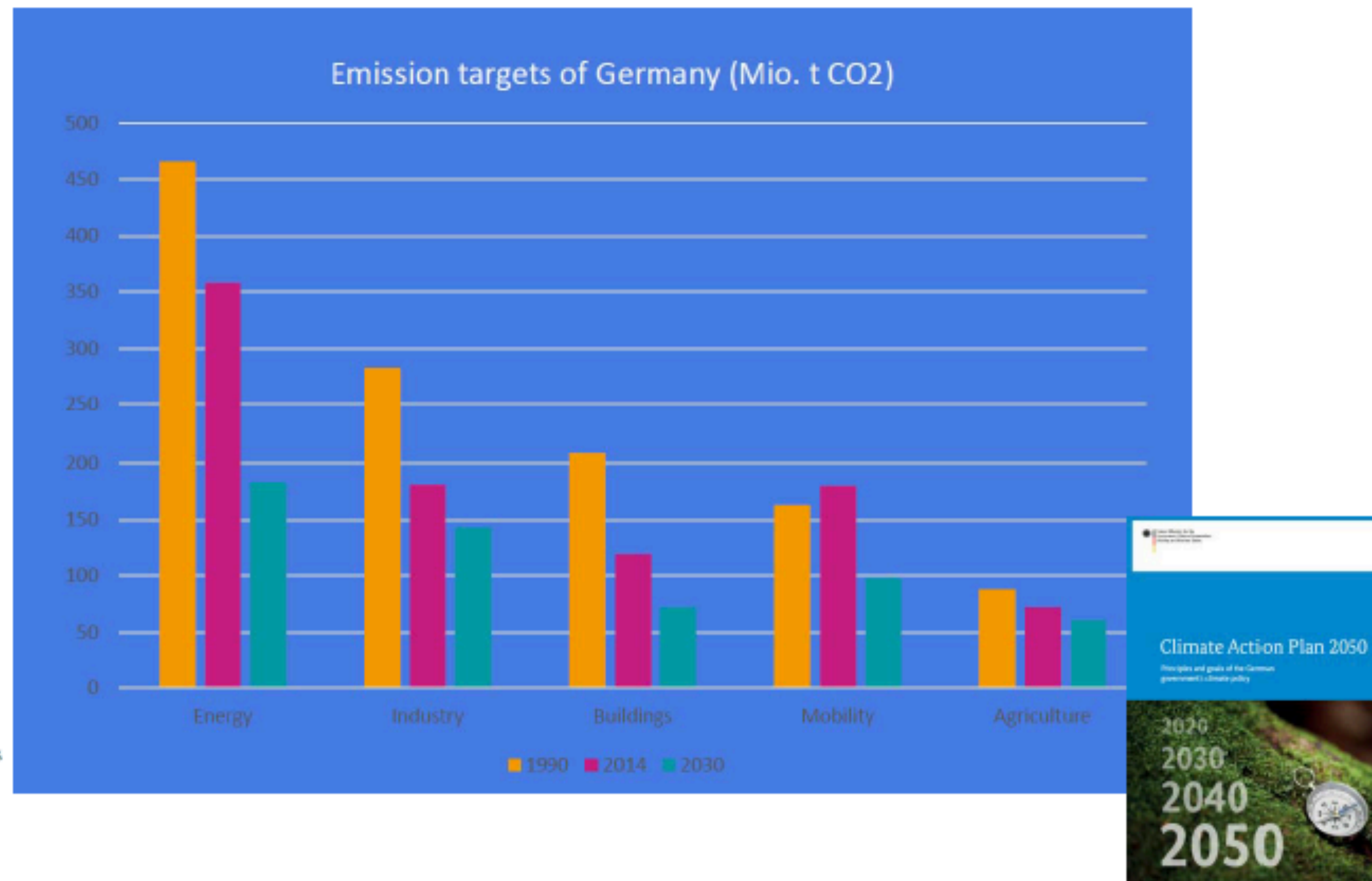
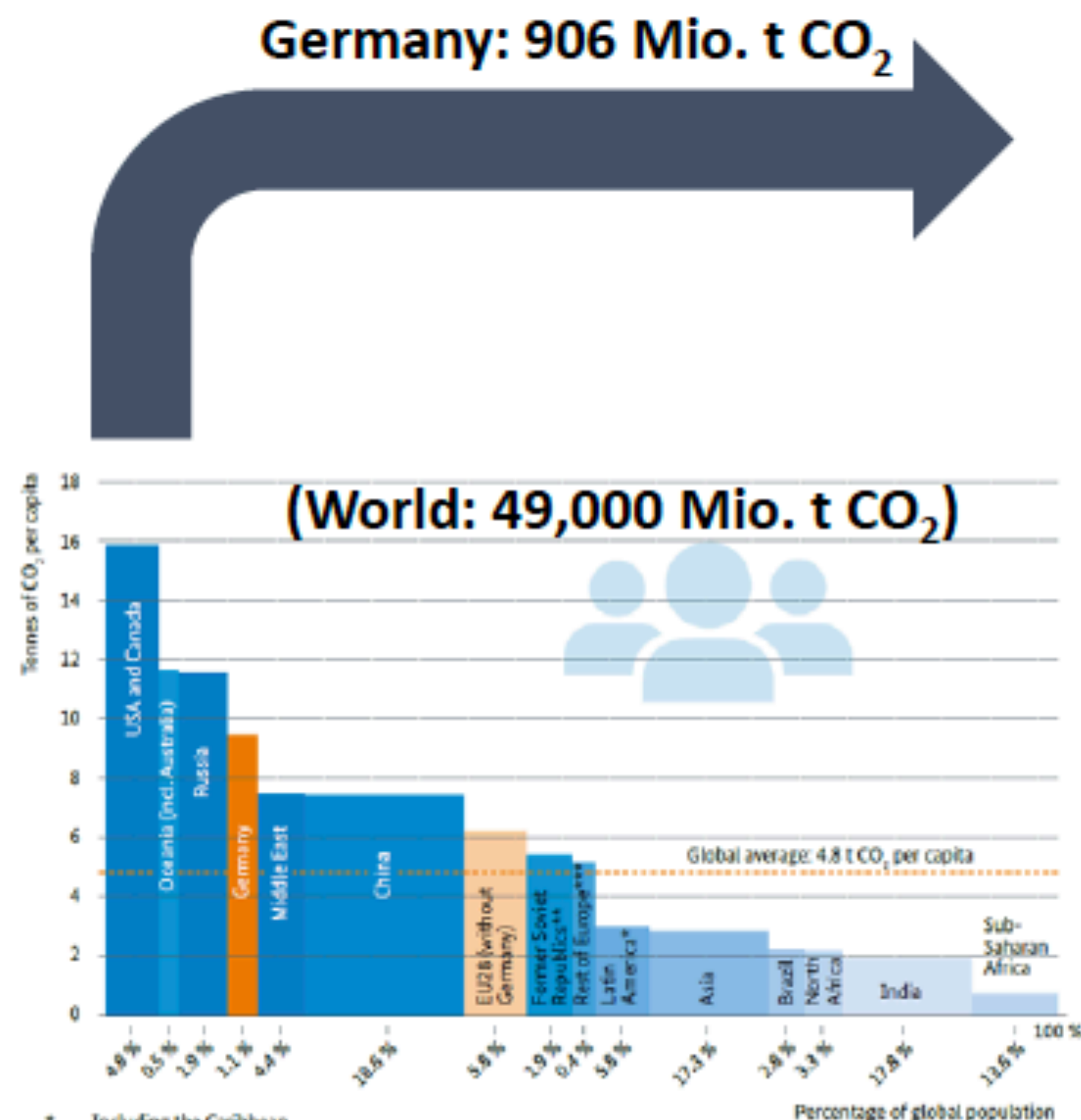
1 Accounting view. 2 Czech gas grid business removed from RAB following sale to RWE in February 2019. 3 Excluding disposal proceeds from sale of CZ gas grid. Capital expenditure on property, plant and equipment and on intangible assets, financial assets ./ . proceeds from disposal of assets/divestitures and net changes in equity.

1. CHANGE DRIVERS OF THE ENERGY BUSINESS

We face significant emission reduction targets....

CHANGE THE CLIMATE CHANGE!

DigiKoo



* Including the Caribbean
 ** Excluding Russia; Estonia, Latvia and Lithuania are included in EU28
 *** The rest of Europe comprises Norway, Switzerland, Iceland and the Balkan States
 Due to rounding, the percentages of the world population do not add up to 100 %

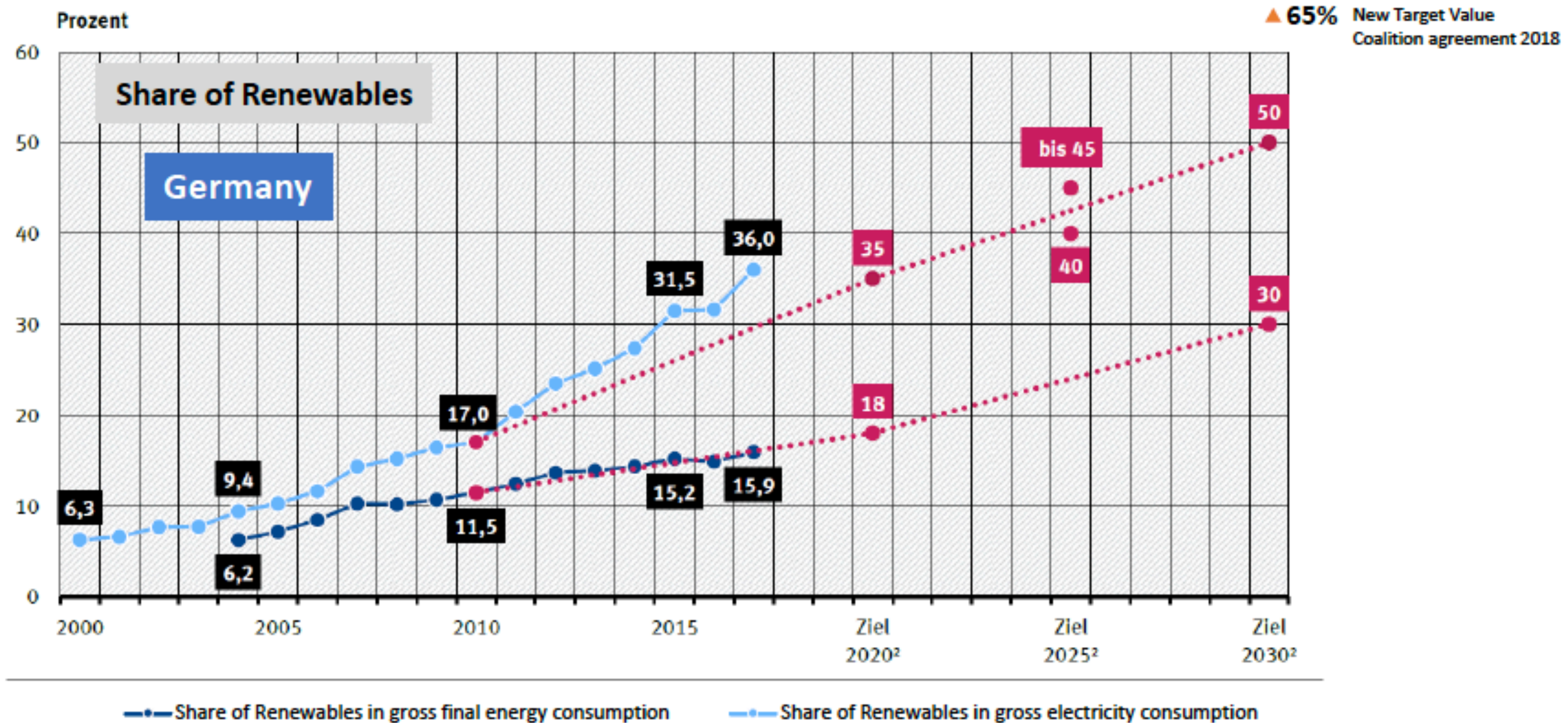
Source: own diagram based on EDGAR (2017); World Bank (2018)

1. CHANGE DRIVERS OF THE ENERGY BUSINESS

...which can only be realised through renewable energy in all sectors (Electricity/Mobility/Heat)...

THE „INTEGRATED ENERGY TRANSITION“ DEPENDS ON RENEWABLE ENERGY IN ALL SECTORS!

DigiKoo



DigiKoo GmbH · Aug 2019

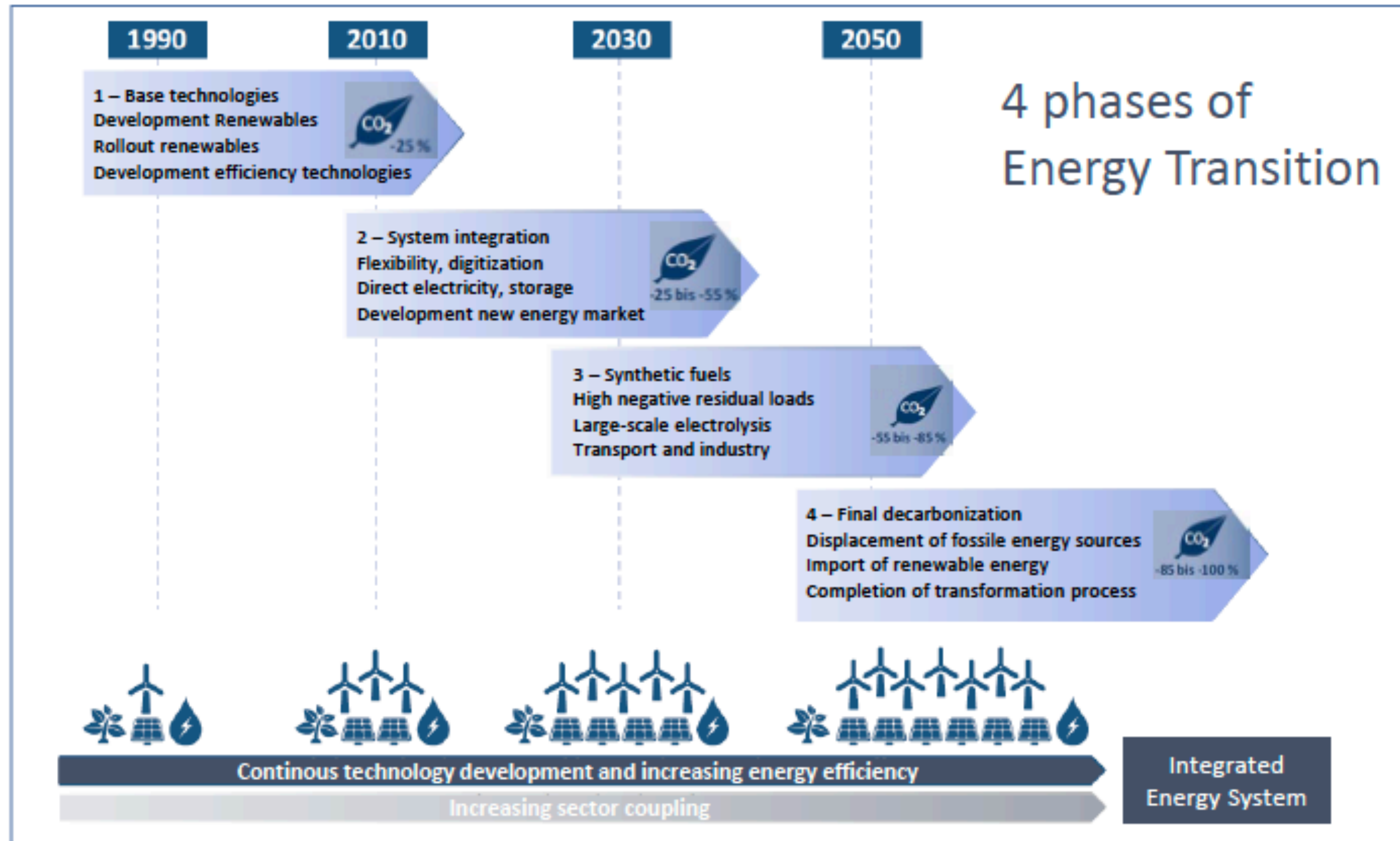
Teil von innogy

1. CHANGE DRIVERS OF THE ENERGY BUSINESS

...via a massive transformation until 2030/2050

THE INTEGRATED ENERGY TRANSITION IS BASED ON 4 STRUCTURAL PHASES!

DigiKoo

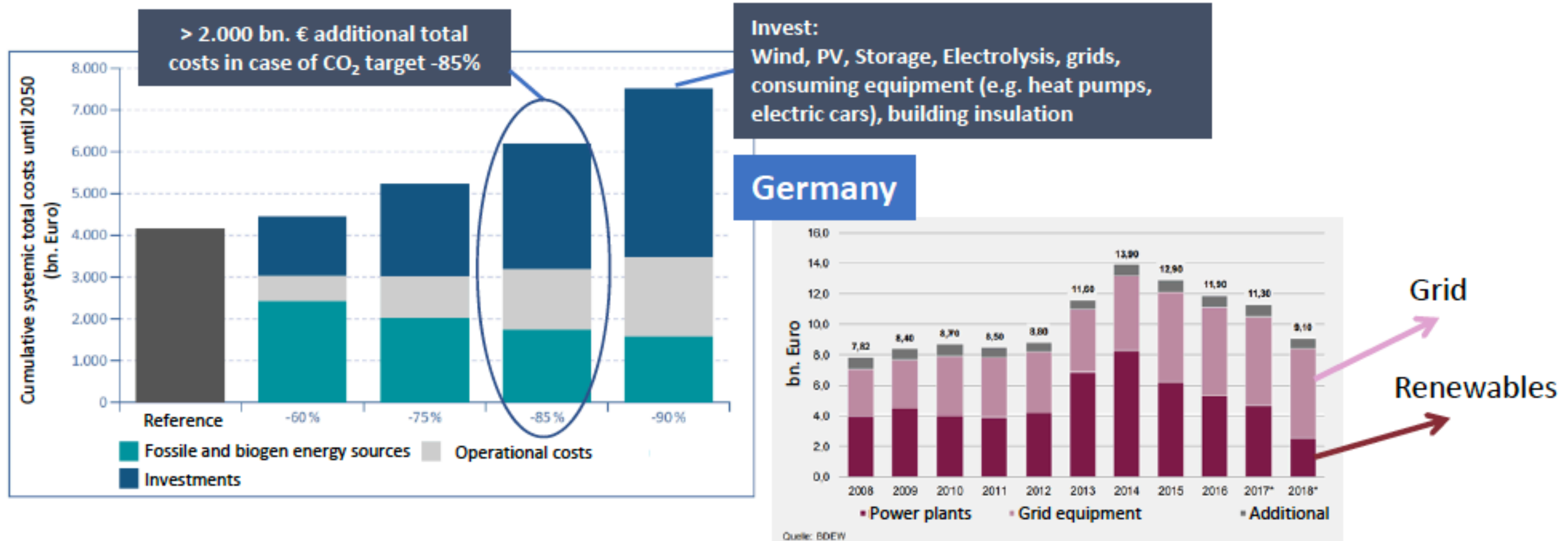


1. CHANGE DRIVERS OF THE ENERGY BUSINESS

This will lead to additional cost/investment of 100 trillion EUR globally and 2 trillion EUR for Germany...

CO₂ REDUCTION IN 2050 LEADS TO SIGNIFICANT ADDITIONAL COSTS!

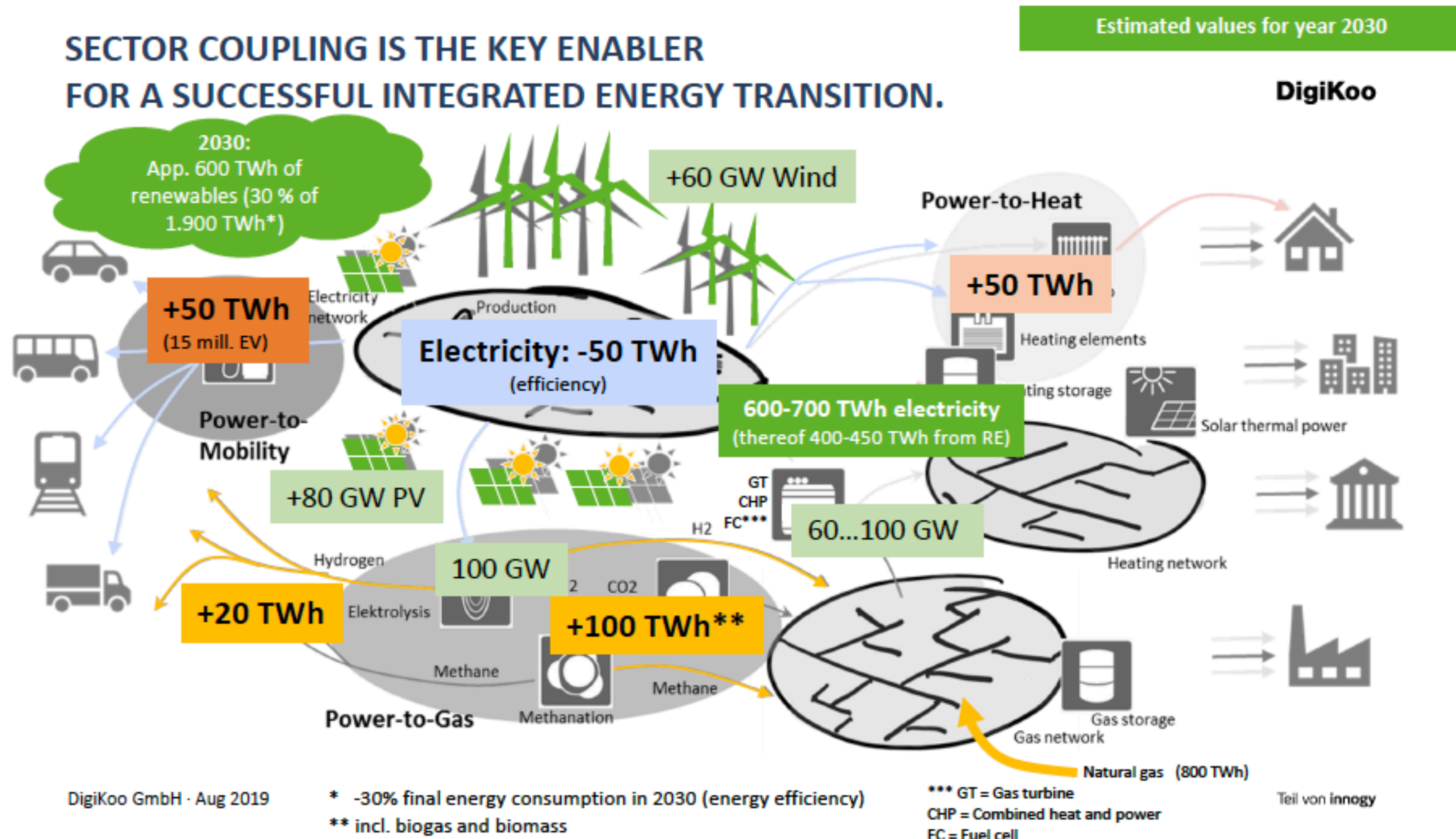
DigiKoo



Germany is responsible for about 2% of the Global CO₂ emission
Global additional costs: 100.000 bn. €

1. CHANGE DRIVERS OF THE ENERGY BUSINESS

...and requires a smart connection of Electricity, Mobility and Heat (sector coupling)



- To enable the future picture and reach our emission goals, data-driven energy and smart networks will play a crucial role
- We need to make our grid infrastructure more data-driven and also leverage our very strong position in grids to develop new data-driven energy business models
- For our customer base in Europe, we need to provide connectivity to the energy system and products/services that enable them to participate and benefit from the energy transition





Australia's Leading Energy Retailer

4.2 million gas, electricity and LPG customer accounts



Large and flexible gas supply

Contract length, cost and transportation flexibility



Growing Renewable Supply

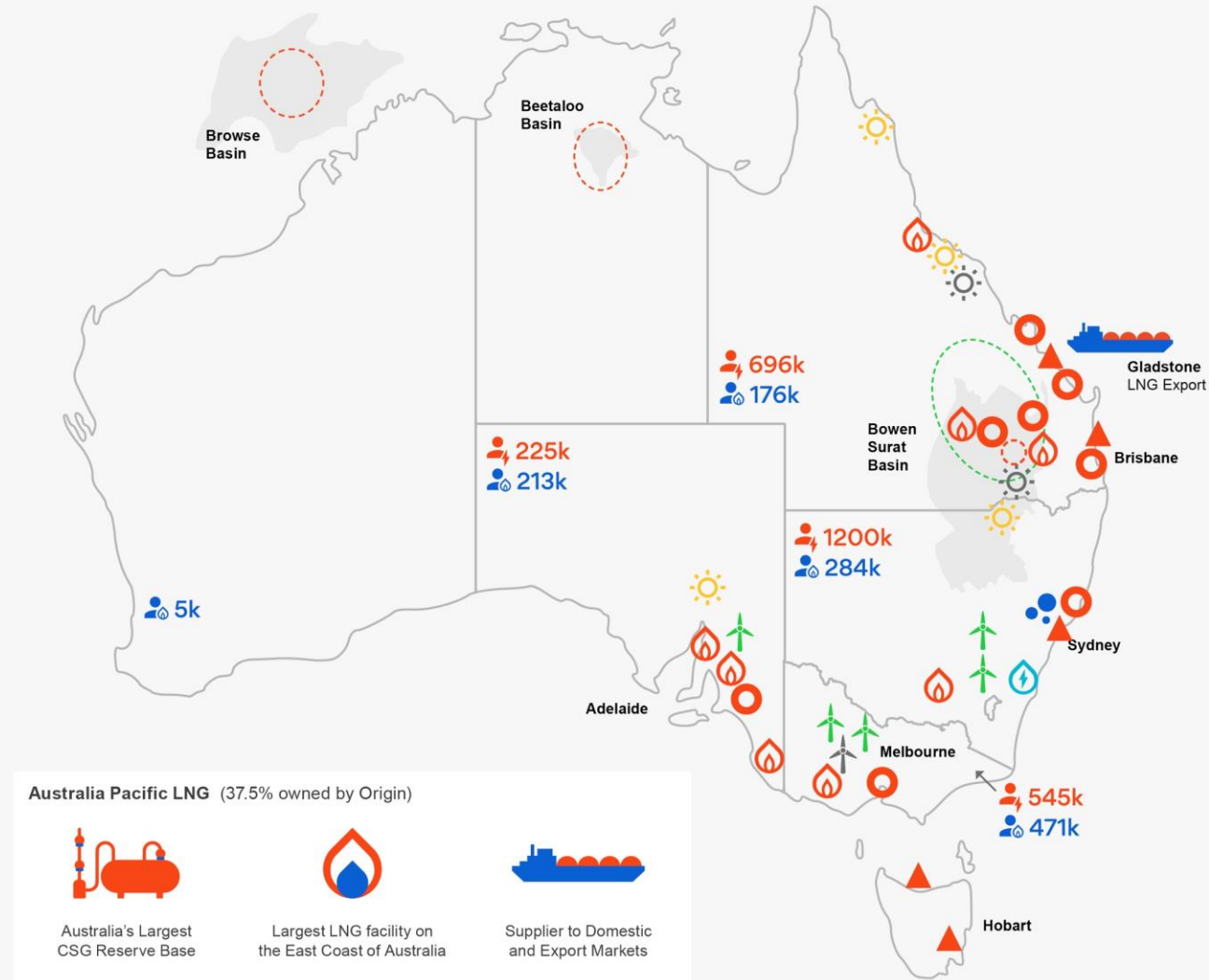
From ~ 19% of Origin's owned and contracted generation capacity today to more than 25% by 2020



Growth Opportunities

- Increase generation flexibility and capacity - brownfield growth and integrate storage
- New revenue streams – centralised energy services, adjacencies

Origin is one of Australia's leading energy companies



Where we operate

Generation

- Gas
- Pumped hydro
- Solar (contracted)
- Wind (contracted)
- Coal
- Under construction

LPG Seaboard Terminal

Electricity Customer Accounts

Natural Gas Customer Accounts

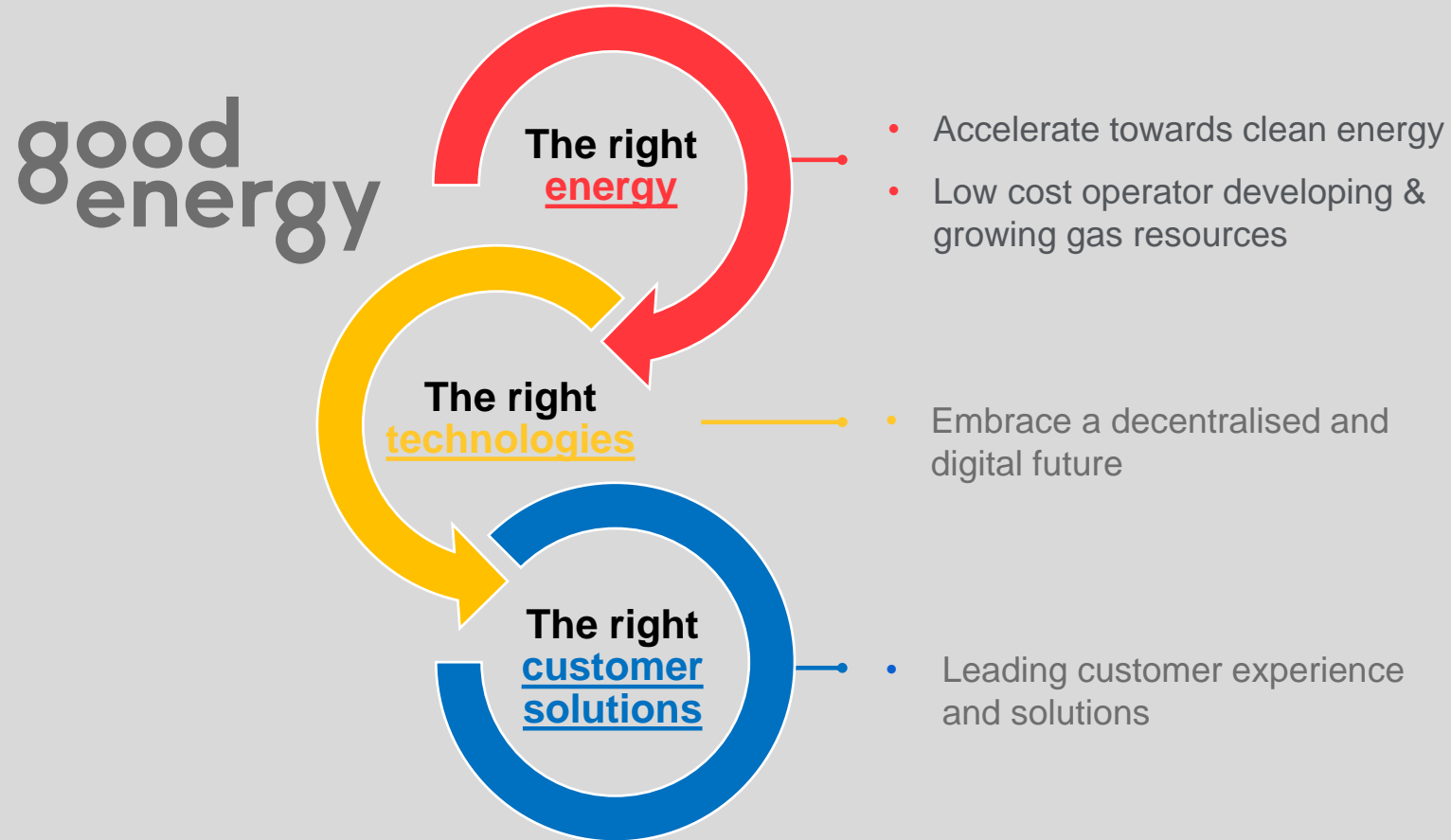
Exploration Acreage

- Origin Upstream Acreage
- APLNG Upstream Acreage
- Production Facility
- Office

Origin also has a presence in California's **Silicon Valley** to better connect us to the global epicentre of digital innovation, and an LPG business throughout the Pacific islands

Strategy to deliver value in the future energy world

Connecting customers to the energy and technologies of the future



Based on our strategic priorities we are looking for innovative ideas in the following areas

Accelerate towards clean energy

- ✓ Innovations that improve the integration of renewables into the existing transmission / distribution network and market structures
- ✓ Integrated inverter / battery solutions for business customers
- ✓ Solutions for the integration of behind the meter assets, compatibility with BMS systems and major asset brands

Embrace a decentralised and digital future

- ✓ Data and algorithms to analyse competitor behaviour and optimise our energy trading portfolio accordingly
- ✓ Propensity modelling of customer take up of batteries and electric vehicles
- ✓ Low cost hardware for customer homes that send sensor data

Leading customer experience and solutions

- ✓ How might non-tech-savvy consumers make their home smart and connected
- ✓ How can energy companies build deep engagement and trust with customers?
- ✓ Data Driven Business Models

Open Innovation

- ✓ New ideas that we haven't thought of !

Broad Categories of Interest

Customer Solutions / Experience B2B & B2C

Energy Storage

Energy Management

Clean Energy

Energy Efficiency

Mobility

IoT

AI / Machine Learning

Origin is open for innovation business



Energy markets around the world are transforming and Australia is no exception

The continued penetration of distributed assets, combined with the rise of IoT devices, are changing the way our customers use energy

Origin believes significant opportunity exists in the transformative impact of decarbonisation, decentralisation and digitisation on the energy sector

Innovation is at the heart of seizing this opportunity

- ✓ We have been **scouting** and **evaluating** hundreds of start ups across a wide range of areas
- ✓ We have been **trailing** a number of technologies and solutions across a range of areas - smart home, IoT devices, storage, demand response, virtual power plants, energy management, AI/machine learning
- ✓ We have **partnered** with and **invested** in a number of start ups in the areas of energy management, renewables, storage, digital rights management, distributed transactions
- ✓ We have a mandate to continue these activities in order to find the right technologies and solutions for our customers



SPgroup

**A leading energy utility company in
Singapore & Asia Pacific**



Core Businesses



Electricity & gas transmission and distribution



Highest reliability
Average Outage Duration
(SAIDI 0.19 min)

Metering & billing service



Convenience to customers
One click, one stop service

Singapore District Cooling



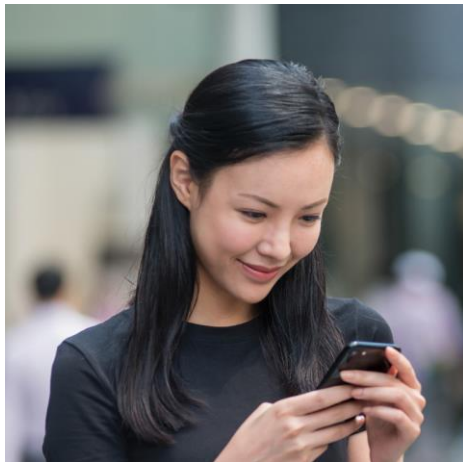
World's largest
underground district cooling network

Poweringthenation.sg

Innovation & Sustainability



Customer App



Helping customers save energy and money

EV Charging



Deploying Singapore's largest public EV charging network

REC Marketplace



One of the world's first blockchain-powered renewable energy certificate marketplace

Poweringthenation.sg

Innovation & Sustainability



PV + ESS



Largest solar rooftop in Singapore with AI-powered digital system

Urban Microgrid



Singapore's first urban micro-grid targets zero-emission

Smart Town



Developing Singapore's first smart energy town in Tengah

Areas of Interest



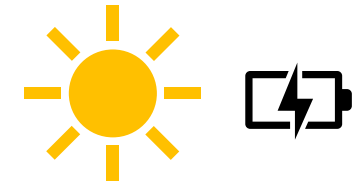
**Energy
Efficiency**



**Electric
Vehicles**



**Distributed
Energy
Resources**



**Cooling
Technologies**



**Digital
Technologies**





TEPCO

TEPCO Research Institute
business-innovation@tepcoco.jp

Night view of Tokyo

1. The largest utility in Japan

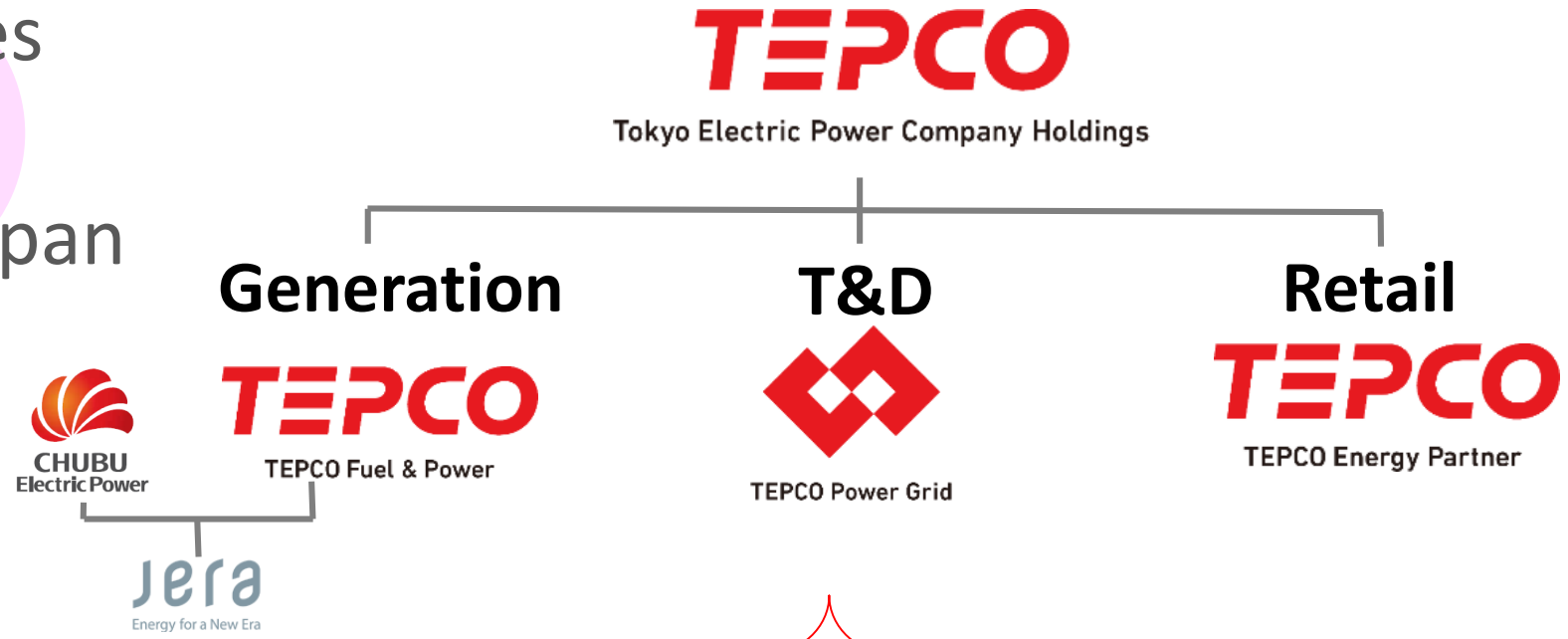


Generates
1/3

Power in Japan

¥5 Trillion
In Sales

29 Million
Customers

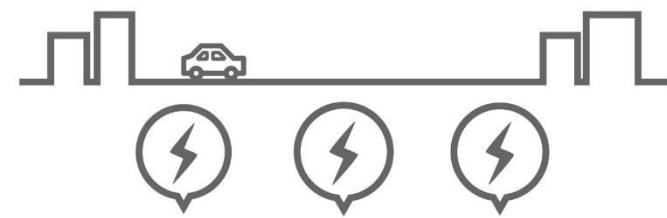


Approx. **40,000** km



Transmission

Total: **1,614** locations
underground: **199** locations



Substation

About **360,000** km



Distribution

2. “5-D’s”

TEPCO believes that the “5-D’s” (the decreasing population, decarbonization, decentralization, deregulation and digitalization) driving social change in Japan present us with an opportunity to evolve so as to be prepared for the age of Utility 3.0* where not only existing energy operators, but also new operators that have digital technology, such as IoT, etc., will cooperate to provide comprehensive social infrastructure.

**Utility 3.0 is the predicted future state of the energy industry as seen based on various social changes and technological innovation.*

Decreasing population

2050 50% decrease in populations in over 60% of regions (depopulation)

2065 Population in Japan: 88 million people

Decarbonization

Paris Accord (25% CO₂ reduction by 2030)

Cabinet Decision (80% CO₂ reduction by 2050) *2013 levels

Decentralization

Decentralized power sources, such as solar and wind power, and the spread of energy-storage technology, such as electric vehicles and heat pump water heaters

Deregulation

Electricity system reforms, gas system reforms

Digitalization

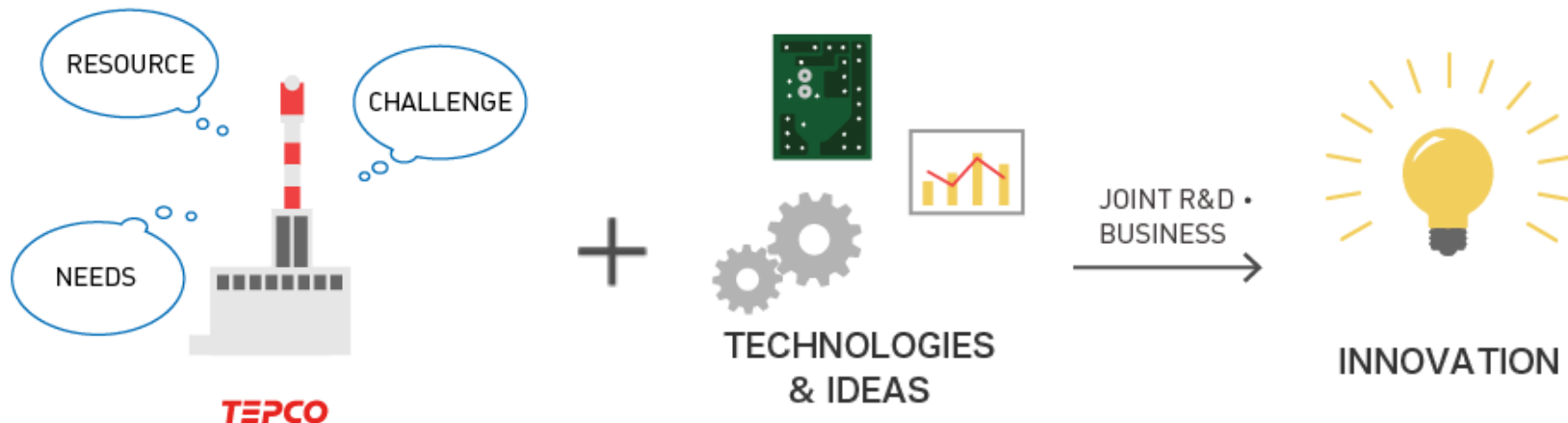
Business of providing “things” → Business of providing “services” through things

エネルギー産業は、人口減少・高齢化 (Depopulation)、脱炭素化 (De-carbonization)、分散化 (Decentralization)、自由化 (Deregulation)、デジタル化 (Digitalization) という5つの要因「5つのD」によって大きな変革期にあります。エジソンにより始まった電化は20世紀の第二次産業革命を支えましたが、この時代に確立された公益事業を「Utility1.0」、自由化されてネットワーク事業が分離され効率性を求められる公益事業を「Utility2.0」とするならば、さまざまな産業と融合しつつさらに進化する公益事業を「Utility3.0」と呼ぶことが期待されています。2030年、2050年の未来において、TEPCOグループの進むべき方向性を展望します。

3. KEY GOALS

- Performance improvement
- Cost reduction
- New revenues / solutions

TEPCO is an extremely large utility that is involved in a wide range of operations, and that has a great number of customers and assets. So even if the impact for each customer or asset is limited, by working with us the overall impact will become much greater. We have high expectations of adopting your technologies and ideas to help us obtain new revenue streams over the next several years.



TEPCO