

ENERGY

# Microgrids

## Trends and Opportunities

**Yatin Premchand**

1 October 2014

## About DNV GL

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On the 12th of September 2013, DNV and GL merged to form **DNV GL**. We are now...

- the **world's largest** ship and offshore classification society
- the **leading technical advisor** to the global oil and gas industry
- a **leading expert** for the energy value chain including renewables and energy efficiency
- one of the **top three** certification bodies in the world



## Industry consolidation (merger)



**DNV·GL**  
2013



1864

KEMA

1927

GL Garrad Hassan

2009

1867



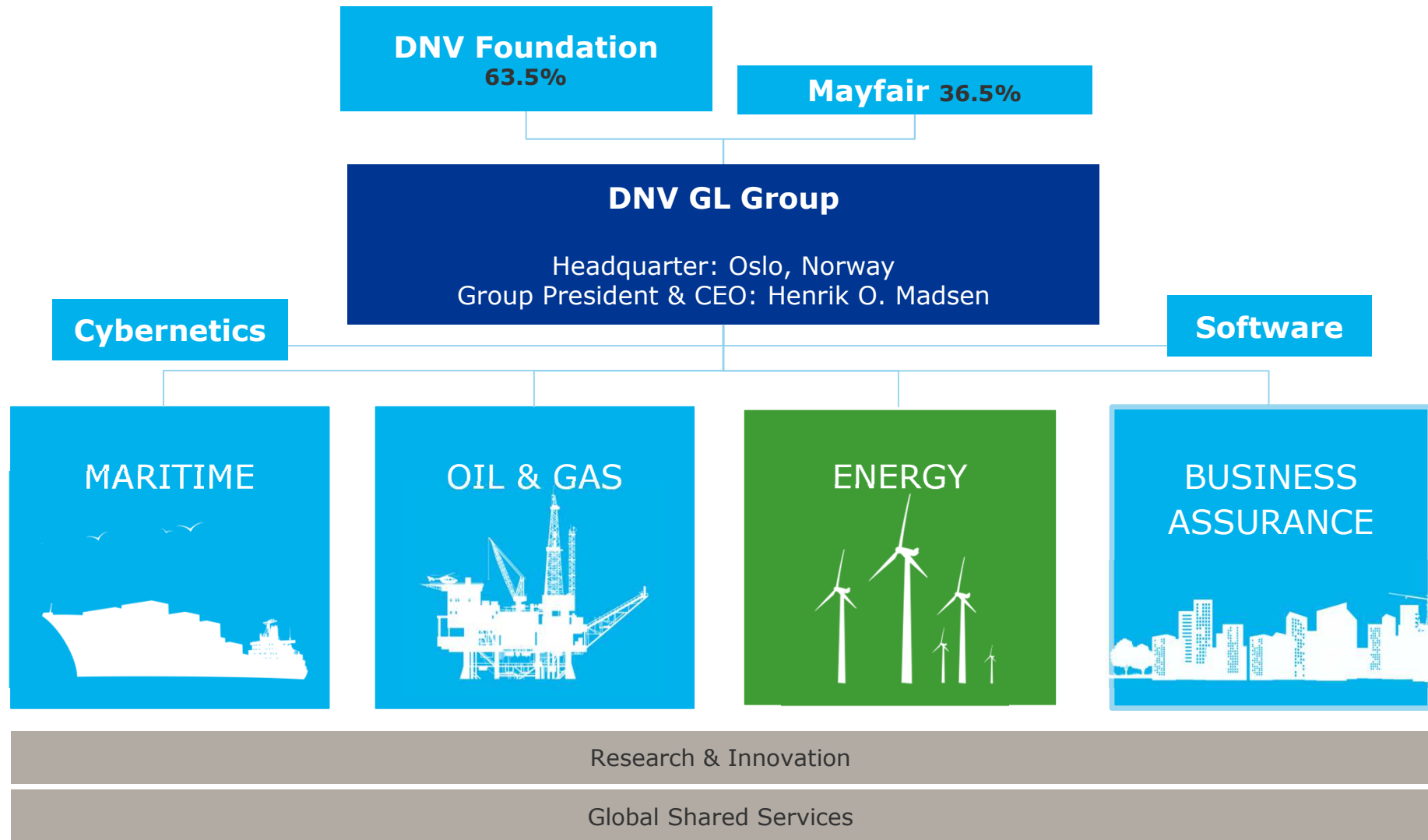
1984



2012



# DNV GL business organization



# ENERGY

Transition to a safer,  
smarter and greener  
energy future

**Increasing  
global demand  
for energy**

**Integration of  
energy markets**

**Climate change  
and extreme  
weather**

**Growing share  
of renewables**

**Security and  
ageing assets**

## An energy technology powerhouse



**No. 1**

in high power and high voltage testing

**25**

Leading certification body with more than 25 standards and guidelines published

**Largest**

independent technical advisor on renewable energy

**3,000+**

independent energy experts

**10**

laboratories incl. world's largest high power and high voltage test lab

**90**

years experience, including 30 years in energy efficiency and wind energy

Global Energy Advisory | 3000 experts | Wind 160+ GW | Solar 7+ GW

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# Global State of Play

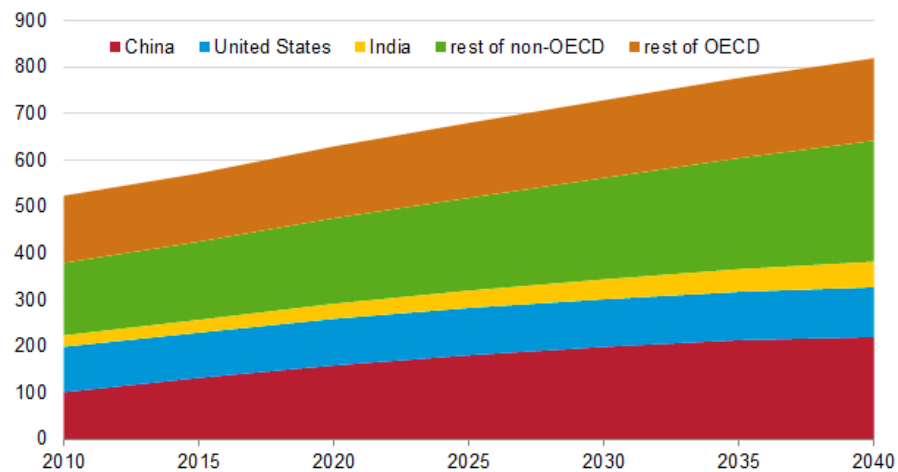
## Energy and Microgrids

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## The Electricity Demand Growth – Worldwide

### World Electricity Consumption by Region

Global primary energy consumption  
quadrillion british thermal



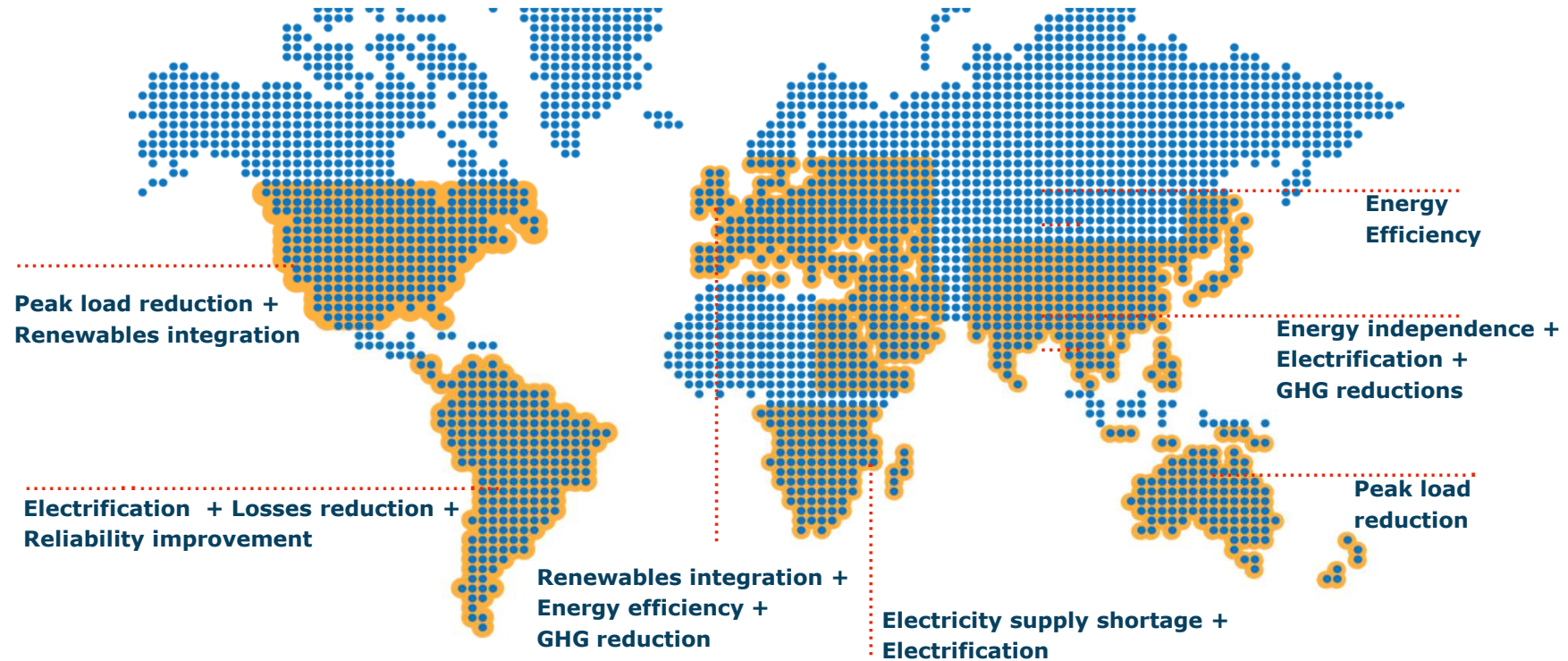
Source: U.S. Energy Information Administration, *International Energy Outlook*, 2013.

- Strong electricity demand growth:
  - Population growth,
  - Increase urbanization;
  - Increase standards of living in non-OECD countries
- In new policies scenario (prices CO<sub>2</sub> per tonne by \$45 in 2035), demand expands by over 70% from 2010 to 2035 with over 80% of the growth arises in non-OECD countries and mainly in Asia (IEA, 2013)
- Over 1.4b people still without energy access today:
  - 400 m in India, 50 m in Indonesia, 45 m in Myanmar



# Distributed Smart and Micro Grid global view

## Policy, strategy, and market drivers vary from one region to another



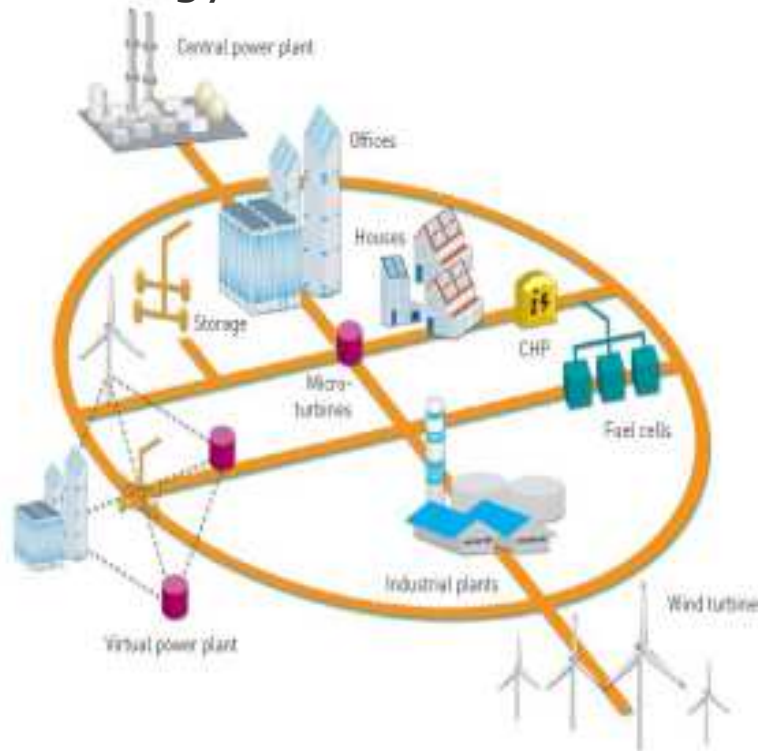
Micro + Smart Grid provides means to:

- Operational excellence
- Environmental compliance
- Grid reliability, safety
- Energy access & Security of supply
- Consumer participation

## Microgrid - Overview

A **microgrid** is a localized grouping of electricity generation, energy storage, and loads.

**Microgrid** generation resources can include fuel cells, wind, solar, or other energy sources in combination with each other. (*gas, deisel, etc.*)



## Significances of Micro-grid

- Ideal for quick electrification to rural areas
  - *off-grid agricultural communities and remote villages*
  - *renewable integration with battery packs and energy storage systems*
- Remote areas such as mining zones
- Island electrification which is not connected to main grids
- Building future grids and interconnected systems "*MesoGrids*" and Smart Grids



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# Case Studies

## Examples of Microgrids Globally

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## Case study 1 : Batanes - PH



### Wind-diesel system on Batanes Island (three Vergnet 60kW wind turbines and two 500kW diesel generators )

|                   |   |
|-------------------|---|
| Investment        | N/a                                       |
| Year of operation | 2004 in Northern Philippines              |
| Developer         | FirstGen                                  |
| Capital Providers | N/a                                       |
| Manufacturer      | Vergnet, further manufacturers not known. |

*The first (and probably only) commercially operated wind-diesel hybrid system in the Philippines, operational since 2004 by FirstGen. 180kW wind with 1MW diesel plant.*

## Case study 2: Esperance - AU



### Wind-gas system (6x 600kW plus 9x225kW turbines from nearby Ten Mile Lagoon)

|                   |                      |
|-------------------|----------------------|
| Investment        | Total cost: AUD10 mn |
| Year of operation | 2004 in WA           |
| Developer         | Verve Energy         |
| Capital Providers | N/a                  |
| Manufacturer      | Enercon, Powercorp   |

*The Esperance project has been operational since 2004, with a 2MW RE component in a 3.2MW grid.*

## Case study 3: Coral Bay - AU



Source: Verve Energy

### Wind-diesel system (3x275kW turbines and low load diesel generator)

|                   |   |
|-------------------|---|
| Investment        | Total cost: n/a   |
| Year of operation | 2007 in WA  |
| Developer         | Verve Energy  |
| Capital Providers | Govt grants; RRP GP (rebate - no repayment); REDI (also no repayment - considered income) |
| Manufacturer      | Vergnet, Powercorp  |

*The Coral Bay project of leading hybrid system developer/utility Verve Energy has been operational since 2007, with a 0.8MW RE component in a 3.1MW grid.*

## Case Study 4: Redeployable Hybrid Power - AU



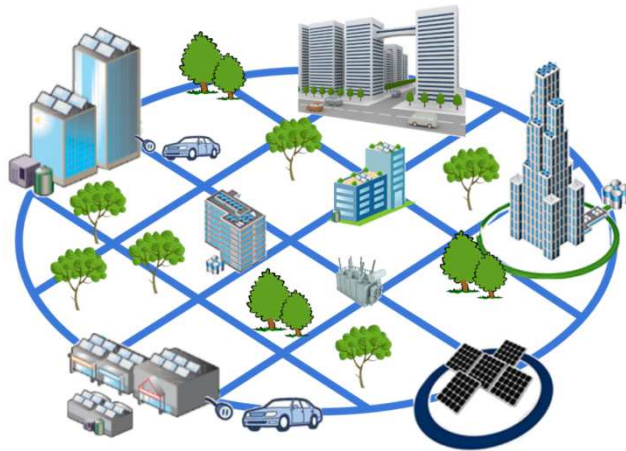
### Hybrid Solar/Diesel Power Plant (1 MW plant with 134 KWp of Solar PV)

|                   |                    |
|-------------------|--------------------|
| Investment        | \$1,400,000        |
| Year of operation | 14 July 2014       |
| Developer         | Laing O'Rourke     |
| Capital Providers | ARENA +            |
| Manufacturer      | Vergnet, Powercorp |

*This project involves a pilot-scale deployment of a fully redeployable hybrid solar/diesel power plant. Laing O'Rourke will construct, set up and pack down a demonstration solar plant. The technology has the potential to change the renewable energy landscape in regional and remote Australia.*



# Hybrid Micro Grid with Smart Grid – SG



**Solar PV (with battery storage)  
+ 3 Bio-diesel Generators and  
Supplies 50Hz AC Power to 45  
Customers**

|                   |                               |
|-------------------|-------------------------------|
| Investment        | Confidential                  |
| Year of operation | 2013                          |
| Developer         | Joint Industry Project + Gov. |
| Capital Providers | Government + Private Sector   |
| Manufacturer      | Multiple                      |

*A Living Microgrid Joint Industry Project (Led by DNV GL, 2014-2016) It is desired to test and validate the system level integration of new individual technology components, as well as to develop actual use-cases through the coordination, integration and interoperability of the various functional sub-systems.*

# DNV GL Microgrid Optimization Tool (MGOT)

### Campus Upgrades

|   |                              |
|---|------------------------------|
| 0 | PV Capacity to Install (kW)  |
| 0 | CHP Capacity to Install (kW) |
| 0 | Power Rating of Battery (kW) |
| 0 | Duration of Battery (hours)  |

|                |                |       |
|----------------|----------------|-------|
| Yearly Results | Daily Analysis | Reset |
|----------------|----------------|-------|

|                    |                 |
|--------------------|-----------------|
| Balance: \$1000000 | CO2 Reduced: 0% |
| Spending: \$0      | Occupancy: 70%  |
| NPV: \$0           | NZE: 0%         |
| Year: 2013         | Score: 0        |

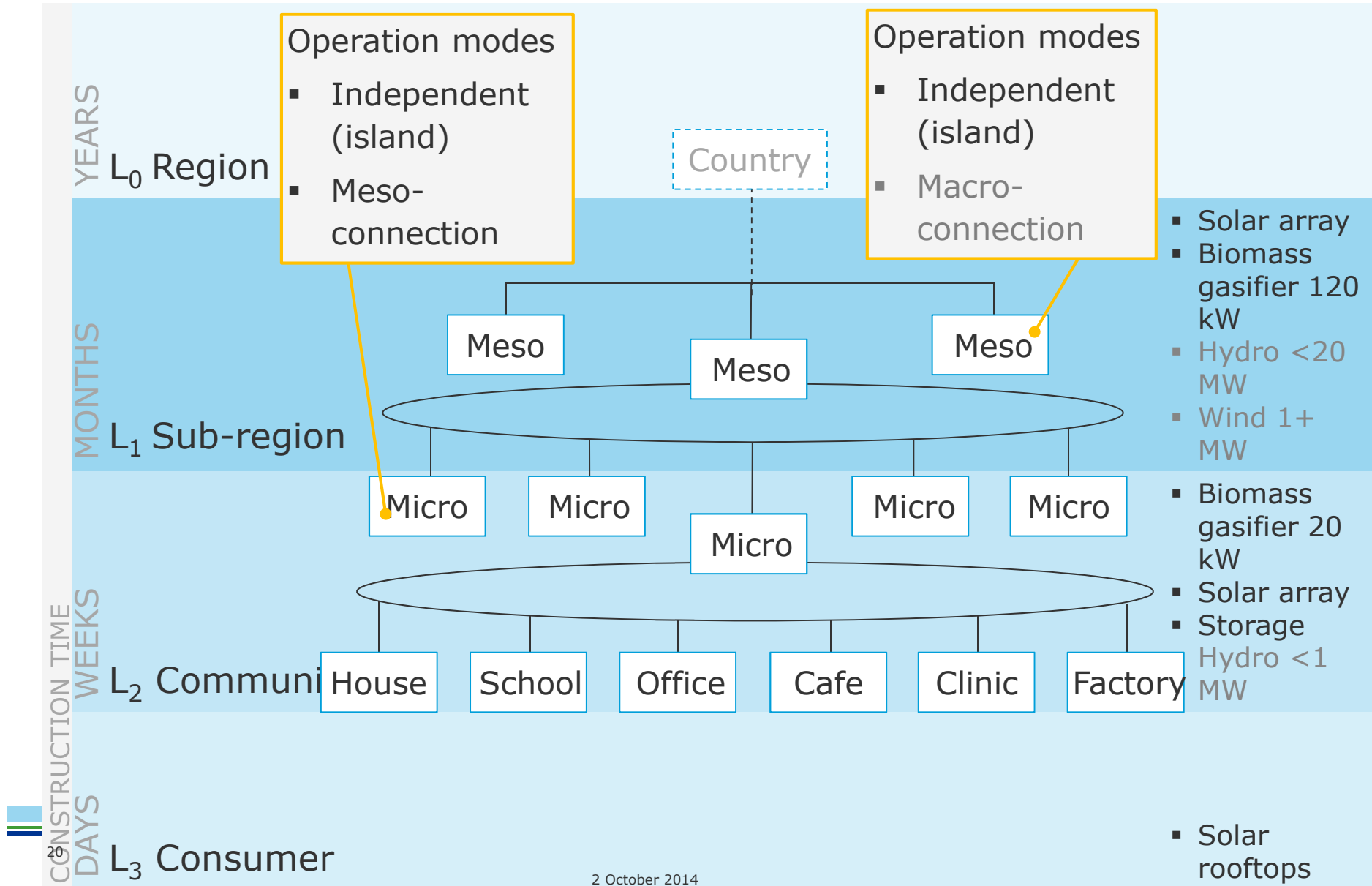
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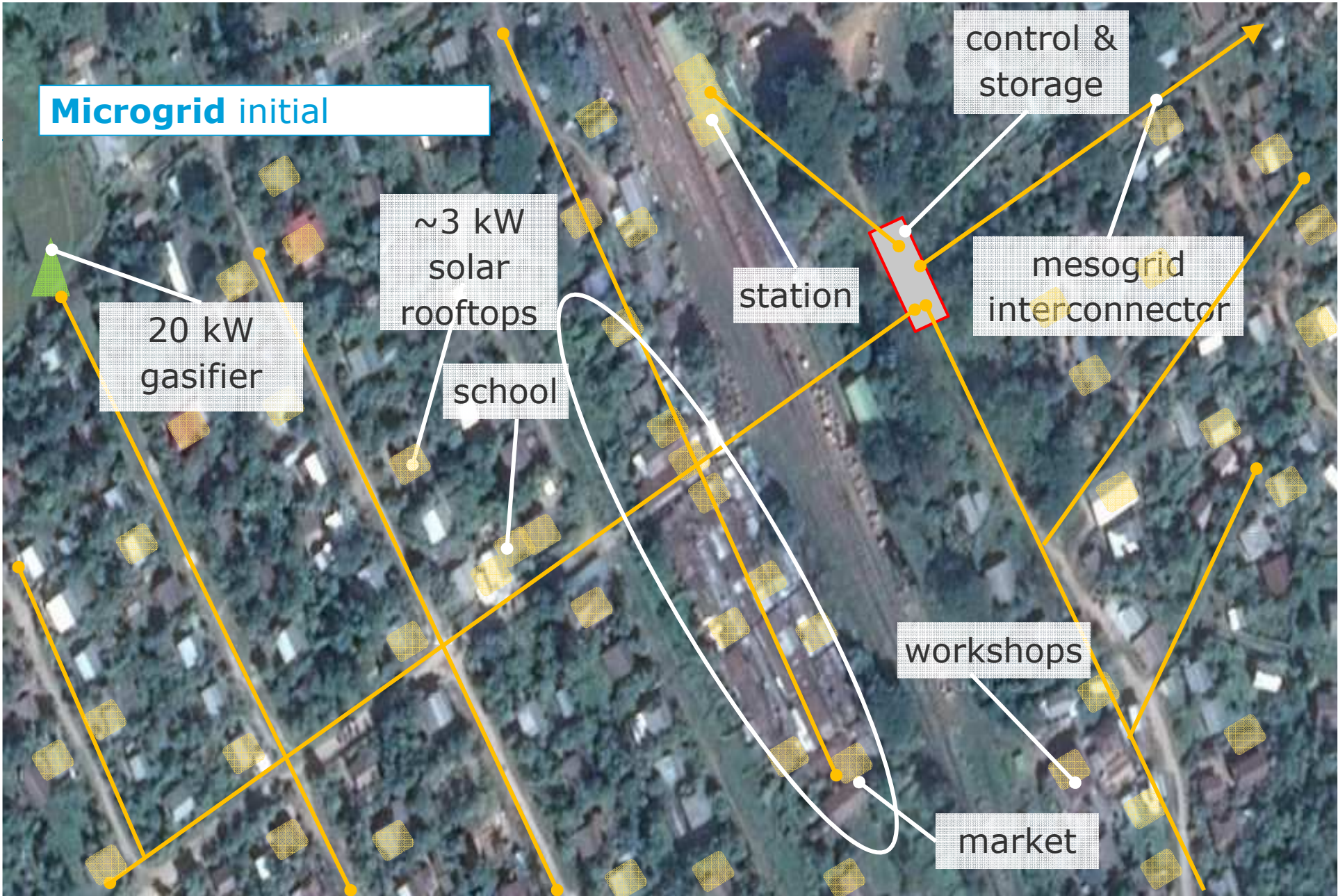
# Evolution of Micro Grids

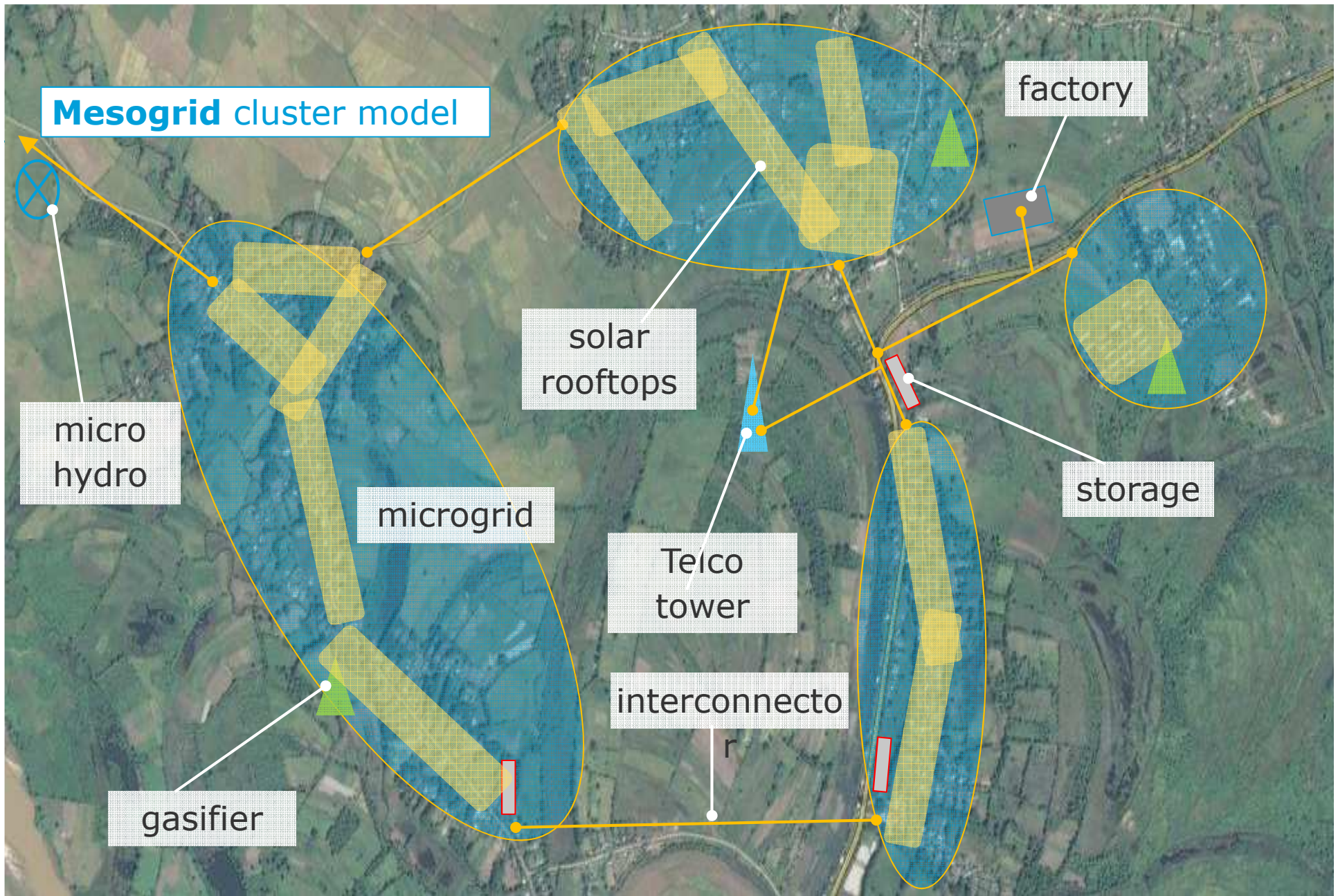
The Not So Distant Future – Organic Grid Growth

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# The Next Evolution in Micro Grids – “MesoGrids”







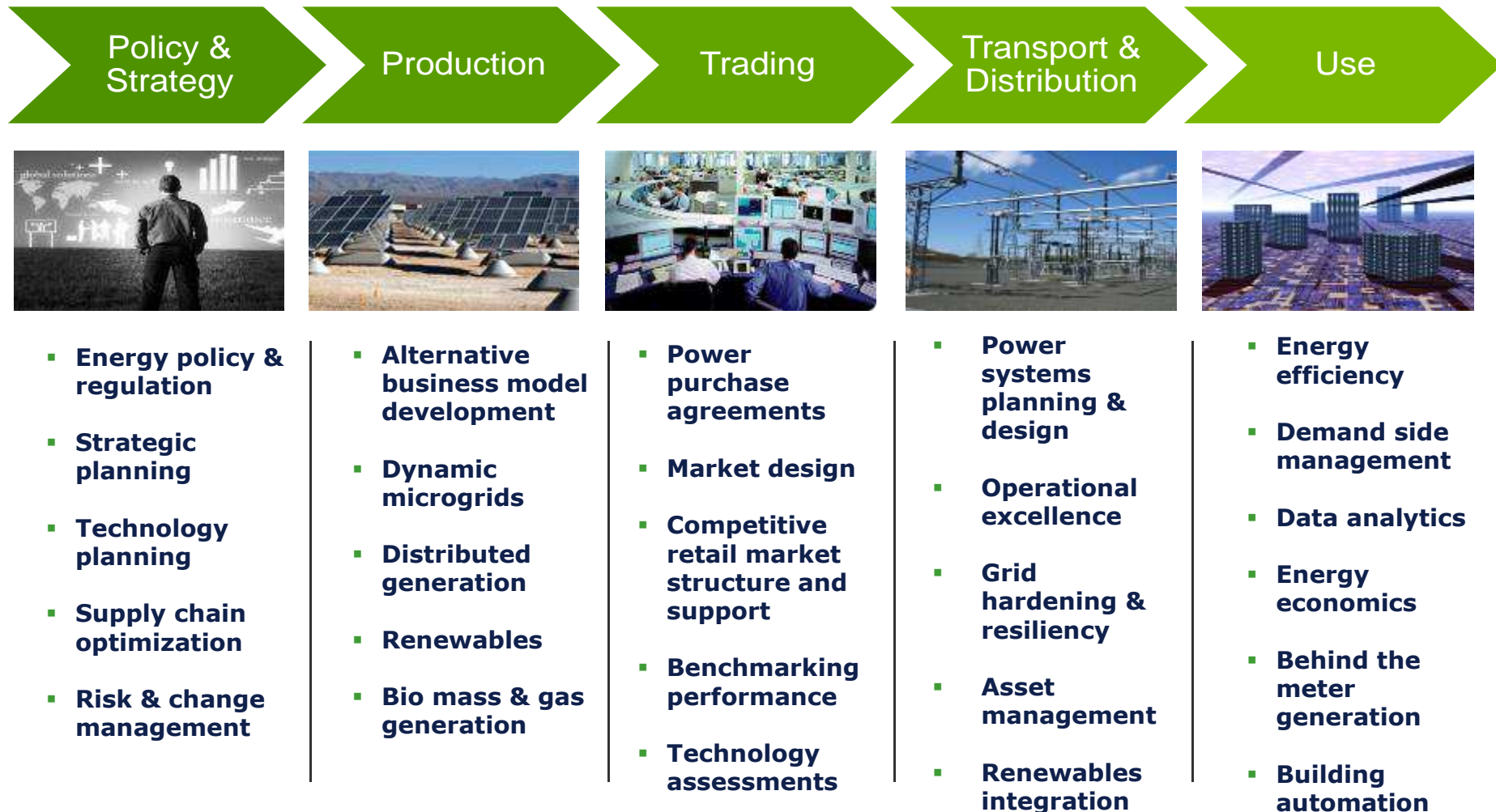
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# DNV GL – Energy

## Energy Value Chain Advisory

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# We combine utility experience with technical expertise to serve clients across the entire utility value chain





# Thank You...

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