



Asia Clean Energy Forum 2017

Session Topic: Managing the Energy Transition

The major transformations in the Energy Ecosystem

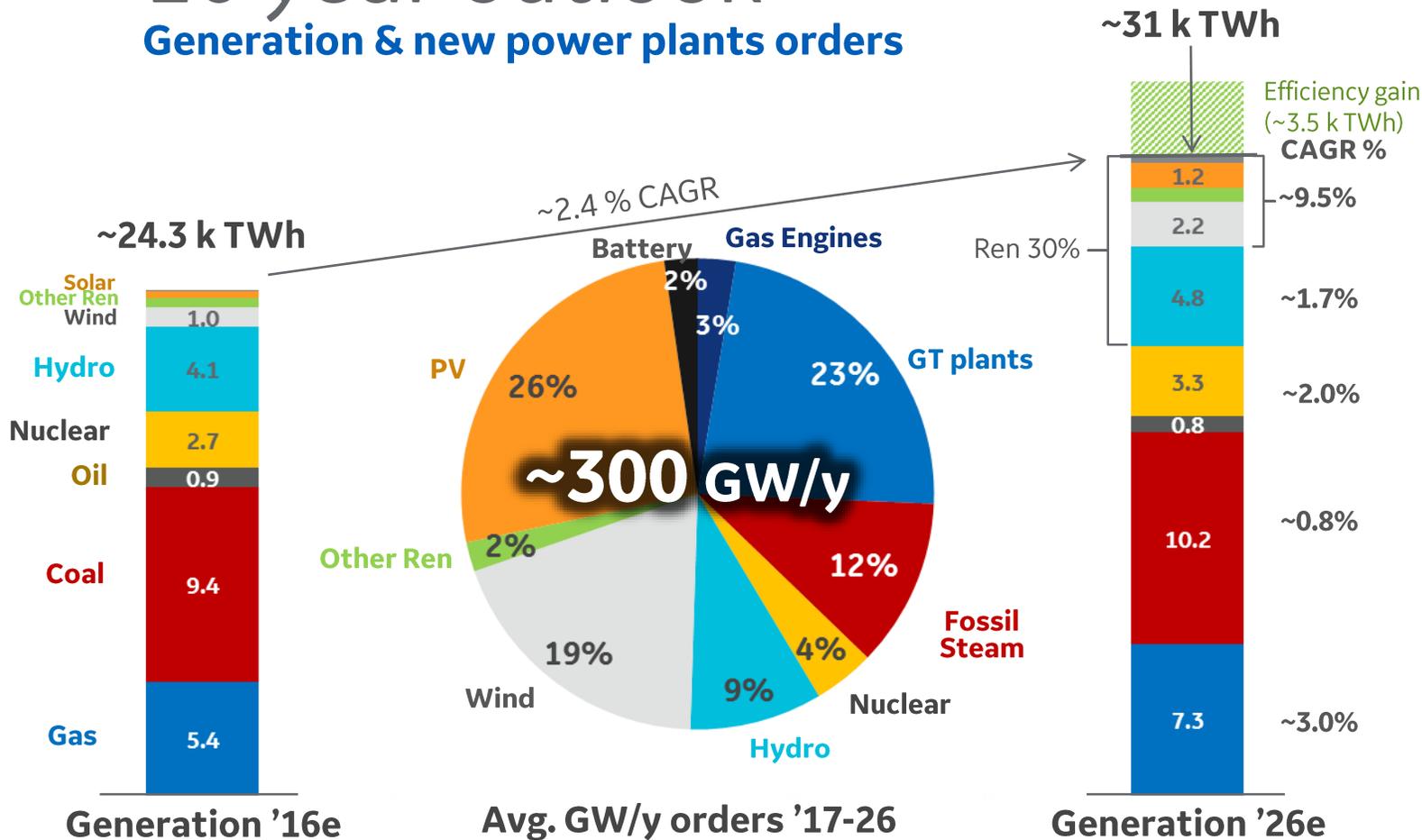
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10 year outlook

Generation & new power plants orders



Continuous order need (GW)

- Peak demand growth plus retirements drive orders
- Renewables supported by environmental policies, but also increasingly by competitive LCoE
- Gas has overtaken coal in new orders
- Financing remains a key driver

Generation mix 2026 (TWh)

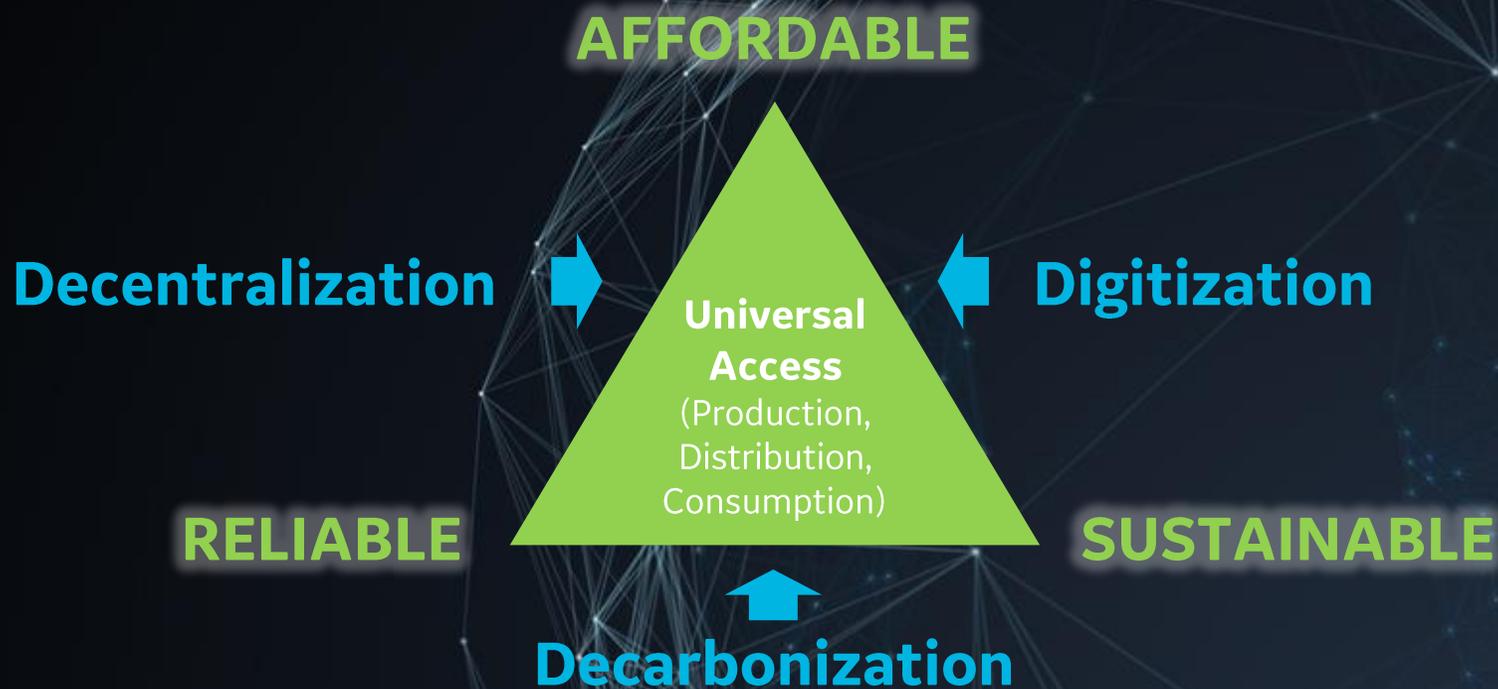
- Demand increase driven by GDP; Gas gaining share but coal remains #1
- Intermittent renewables increasing and pushing thermal utilization down
- EVs become a serious factor beyond 2026

Fundamentals remain strong ... most generation growth from gas and renewables

Notes: 1) PG oil recip. are not included. 2) TWh excludes oil recip & battery generation. 3) Efficiency gain results from electricity intensity reduction. Source: GE Power Marketing Forecast MACA 2017



Energy Ecosystem defined



Electrical
Consumption

Transmission &
Distribution

Electricity
Generation

Refining &
Processing

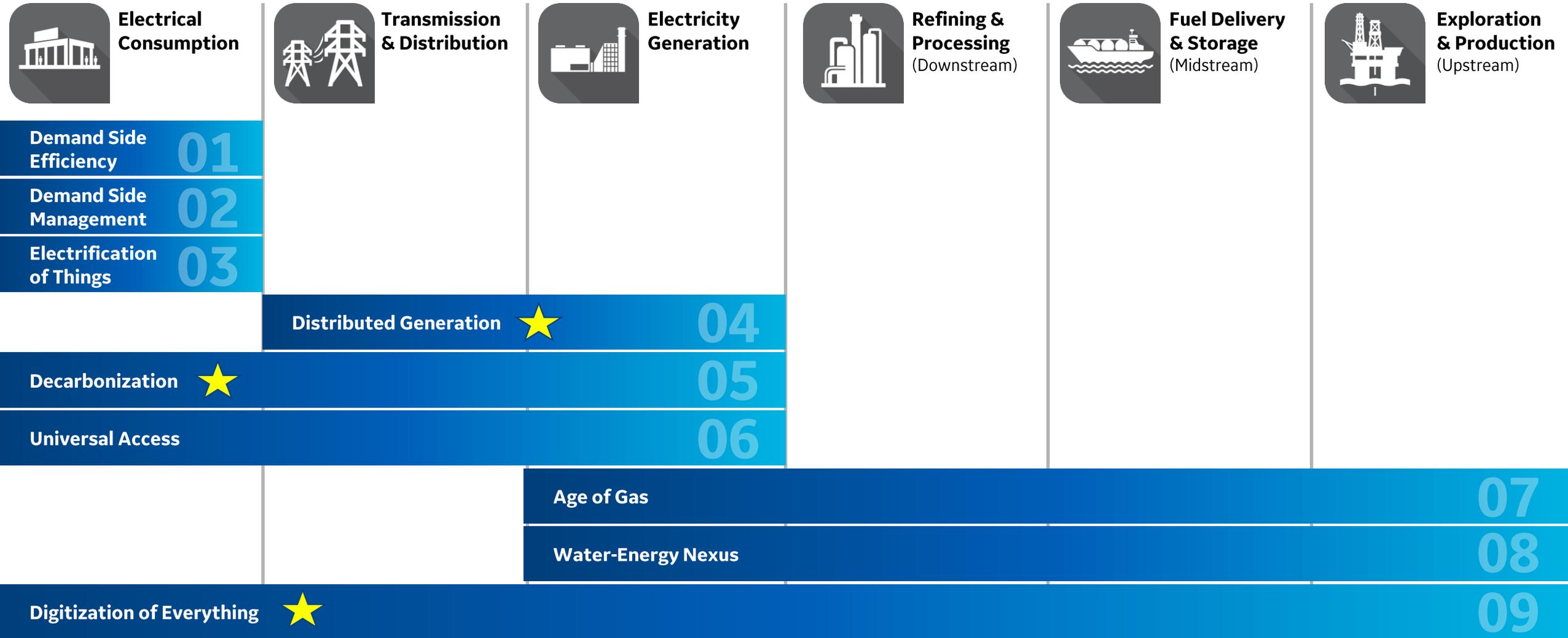
Fuel Delivery
& Storage

Exploration
& Production



Digital Thread

Transformations across the energy ecosystem



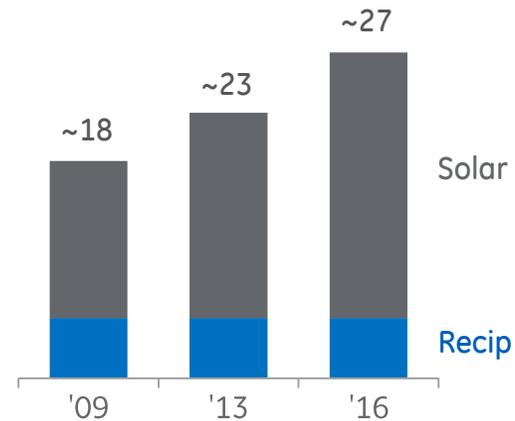
04: Distributed Generation



The shift from central power generation towards generation closer to the point of consumption (e.g., rooftop solar, industrial self-generation)

Onsite Power

Annual Installs (GW)



Rooftop solar growing ...
~21GW in '15, policy enabled

Combined Heat & Power...
90%+ efficient, ~6GW / yr. gas
GT & recip

Challenges ...

- Traditional utility business models stressed as more customers self-generate
- Ensuring reliable power delivery with “two-way” power flows
- Incorporating more resources that are variable and uncertain in nature

Opportunities...

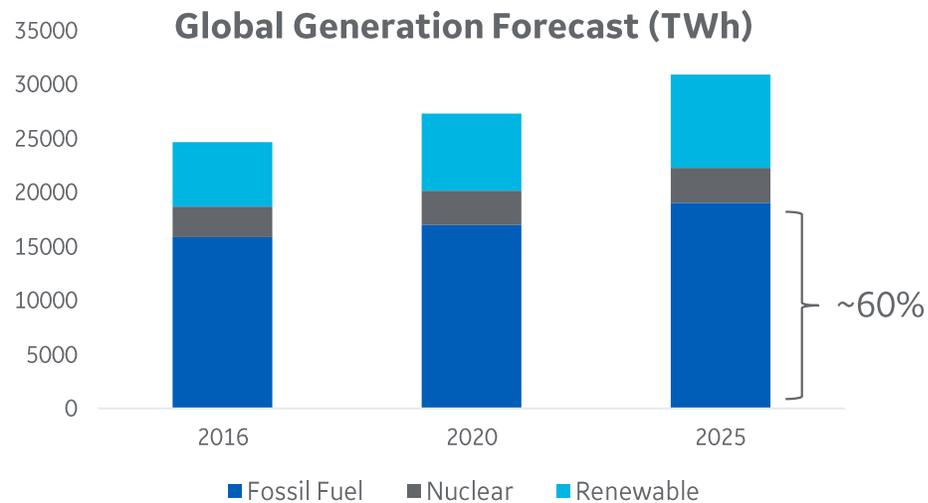
- Provide end-consumers with more sustainable and cost-effective electricity
- Enhance system reliability by islanding during grid outages
- Ensure more efficient distribution system design and upgrades



05: De-carbonization via IB efficiency

Future generation mix

- ~60% generation in 2025 from fossil fuels
- Steam coal expected to increase by ~284 GW by 2025



Increase in efficiency in...



Natural Gas

↑ 39.4% to 42.7%

↓ CO2 by 203 mt/year



Coal

↑ 34% to 38%

↓ CO2 by 924 mt/year



1% ↑ in COAL efficiency...
Equals ~63K 1.92 MW wind turbines

High efficiency GT and coal technology critical to meet global demand and CO₂ goals



09: Digital Transformation of Electricity



Generation



Market Operational Trading



Transmission



Distribution



Distributed Energy



Behind the Meter

\$1.3 Trillion Industry Value

75% of Breakdowns

8% Electricity Loss

New Integrated Customer Service

Managing the transition ...

1. **Policy** ... critical to shape right in-country policies
2. **Distributed generation** ... portfolio of solutions to integrate
3. **Emission** ... addressing the gap vs. COP 21 Nationally Determined Contributions
4. **Digital** ... support for high level technologies for high quality infrastructure projects, including digital
5. **Critical infrastructure** ... building more resilient & integrated energy market (e.g. regional interconnection)

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