Global Energy Transformation
Challenges and solutions for the power sector
We are seeing the impact of megatrends on all sectors across the globe

**Megatrends**

**Demographic and social change**
- From 7 to 8 billion people in the next 10 years
- Half of the girls born today have a life expectancy of at least 100 years.

**Shift in global economic power**
- Welfare growth – by 2030 the E7 will overtake the G7
- How to secure sufficient capital for investments?

**Rapid urbanisation**
- In 1800, only 2% of the world’s population lived in cities – now it is 50%.
- Two-thirds of the world’s population will live in cities by 2050.

**Climate change and resource scarcity**
- A challenge is Supply of resources keeping up with demand growth while reserves are finite
- The carbon target to keep temperature rises to 2°C is will be missed by 2034.

**Technological breakthroughs**
- Costs of new technologies fall dramatically and adaptation speed rises.
- Achieving a 50% penetration rate for telephones took decades, while mobile phones took <5 years.

“Energy is at the heart of these trends, both as an essential resource for feeding and fuelling the world population and economy, and also as a sector strongly influenced by renewable technologies and business model innovation”
These megatrends are leading to disruptive dynamics impacting the power sector

Disruptive dynamics

**Customer behaviour**
- Grid provides back up
- Less need for utilities, consumers produce and store energy themselves

**Competition**
- Outflanked & outpaced
- More nimble and able competitors seize key revenue segments

**Production service model**
- Outdated or stranded
- Outdated or out-of-market assets leads to stranded investments

**Distribution channels**
- Digitalised intervention
- Innovative digital platforms matching demand and supply become dominant

**Government and regulation**
- Caught in the crossfire
- Shifting policy goals and regulatory risk undermine business decisions

Disruption profiles differ by region

- **Europe**
  - European utilities value reduced by ~60% between 2008 and 2014
  - ~$20B+ in cleantech venture capital funding between 2008 and 2014

- **Asia**
  - Black outs hinder economic development: $6.2 trillion needs to be invested in the power sector by 2035*

- **North America**
  - (country)

- **Africa**
  - Technology supports policy aims – 160m new grid connections are required to be supplied by micro-grid and off-grid systems

### European example – Market demand will remain, however value pools will shift “downstream” towards behind-the-meter segments

#### Evolving Energy Value Chain

<table>
<thead>
<tr>
<th>Centralised generation</th>
<th>Transmission &amp; distribution</th>
<th>Trading &amp; retail</th>
<th>Metering</th>
<th>Behind-the-meter (BTM)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Drivers of value shift</strong></td>
<td><strong>Value (growth/decline)</strong></td>
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</tr>
<tr>
<td>From power provider to power guarantor</td>
<td>Down</td>
<td>From multi-directional and volatile energy flows, 50% more network capacity is required to meet similar demand</td>
<td>Down</td>
<td>Higher competition upstream – more power to consumers</td>
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<tr>
<td>Falling demand as result of economic crisis, manufacturing declines and energy efficiency</td>
<td>Down</td>
<td>Reducing demand for grid power</td>
<td>Down</td>
<td>Maturing DG, storage and EV technologies – new growing market for installation, leasing and service</td>
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<tr>
<td>Significant overcapacity in fossil-fuel-fired gen.</td>
<td>Down</td>
<td>Emerging role of the complex system operator</td>
<td>Down</td>
<td>Increasing level and volatility of power prices increases value of energy management services</td>
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<tr>
<td>Low plant utilization</td>
<td>Down</td>
<td>• Falling demand</td>
<td>Down</td>
<td>Demand for usage insights and control solutions</td>
</tr>
<tr>
<td>Growth in higher-priority renewables</td>
<td>Down</td>
<td>• Fierce price competition</td>
<td>Down</td>
<td>Demand for holistic home services</td>
</tr>
<tr>
<td><strong>Sources:</strong> Expert interviews, PwC/Strategy&amp; analysis</td>
<td></td>
<td>• Increasing customer churn</td>
<td></td>
<td>Emergence of local island grids</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Expanding into energy services</td>
<td></td>
<td>Residual demand visible for upstream player – exposed to risk of surges in demand or supply</td>
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<tr>
<td></td>
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<td>• Increasing pressure from trading regulation</td>
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<td>Value is shifting towards behind the meter segments</td>
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- From power provider to power guarantor
- Falling demand as result of economic crisis, manufacturing declines and energy efficiency
- Significant overcapacity in fossil-fuel-fired gen.
- Low plant utilization
- Growth in higher-priority renewables

- From multi-directional and volatile energy flows, 50% more network capacity is required to meet similar demand
- Reducing demand for grid power
- Emerging role of the complex system operator

- Falling demand
- Fierce price competition
- Increasing customer churn
- Expanding into energy services
- Increasing pressure from trading regulation

- Growth in advanced metering (infra) to optimize demand patterns
- New data-driven services, e.g. energy advisory, demand response

- Higher competition upstream – more power to consumers
- Maturing DG, storage and EV technologies – new growing market for installation, leasing and service
- Increasing level and volatility of power prices increases value of energy management services
- Demand for usage insights and control solutions
- Demand for holistic home services
- Emergence of local island grids
- Residual demand visible for upstream player – exposed to risk of surges in demand or supply

**Value is shifting towards behind the meter segments**
Companies must adapt to remain competitive in this new world

**Competitive environment**
- How quickly will my market change?
- Who are my new competitors?
- What is the government doing in order to achieve policy goals?

**Customers**
- How are my customers changing?
- Which customer segments and geographies do I want to serve and how?
- What are customers willing to pay for new services?

**Business model**
- What are the new value pools in the market and what should be my focus?
- How should I adapt my current business model?
- How can I enter the market?

**Operating model**
- How do I align my operating model and culture?
- How do I finance this path of change?
- How can I put technology at the forefront of my operations?
We believe that the disruptive dynamics are causing transformational change in power markets

<table>
<thead>
<tr>
<th>Driving force in energy sector (stakeholder importance)</th>
<th>BAU</th>
<th>Incremental change</th>
<th>Transformational change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumers</td>
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<td>Ultra distributed generation</td>
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<tr>
<td>Private sector</td>
<td>Classic energy markets</td>
<td>Market led innovation</td>
<td>Regulatory led innovation</td>
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<tr>
<td>Government</td>
<td>Classic energy system</td>
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<td>Green command &amp; control</td>
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</tbody>
</table>

Level of technological change
**New transformational market models will emerge as markets shift away from incremental change**

**Market models**
- Regional super-grid
- Green command and control
- Ultra distributed generation
- Local energy systems

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>low</th>
<th>high</th>
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<td>digitalisation</td>
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<td>New entrant</td>
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<td>opportunities</td>
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**Local factors**
- Mature national infrastructures
- Limited indigenous fuel sources
- Clear cost benefits of market integration
- Political stability
- Limited private sector involvement
- Government direction on capital investment
- Reliability and price stability are valued over cost
- Mature infrastructure
- Strong customer engagement in micro-generation
- Interest from private capital
- Average/peak demand differential
- Sufficient private funding
- Rural electrification policy
- Interest from private capital
- Local communities taking control
Utilities need to break out from traditional business models to be competitive in transformational markets

New service offerings e. g. aggregator
Declining revenues
Lower consumption
Reduced financial capacity
Innovation from others
Stranded assets
Technology support for customer demand management
Investment to enhance environmental reputation

Megatrends | Disruption factors | Market models | Business models | Draft
In defining a future business model(s), companies need to first align on several fundamentals ...

**Foundation strategy factors**

- **Where do we play?**
  - Determine our “**purpose**” and desired outcomes, e.g. “end-to-end” participation or selected parts of the value chain

- **How do we play?**
  - Establish the “**positioning**” we wish to achieve, e.g. full offering portfolio or highest value products

- **How do we win?**
  - Define the “**role**” we would like to perform, e.g. go it along or strategic partnering

**How competitors choose to play impacts our choice of business model?**
... and then determine the dimensions of its available options

<table>
<thead>
<tr>
<th>Emergent roles</th>
<th>Energy supplier</th>
<th>Integrator</th>
<th>Enabler</th>
<th>Optimizer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary segment focus</td>
<td>Generation</td>
<td>Transmission/distribution</td>
<td>Distribution/customer</td>
<td>Customer</td>
</tr>
<tr>
<td></td>
<td>“Asset focused”</td>
<td>“System focused”</td>
<td>“Value focused”</td>
<td>“Insight focused”</td>
</tr>
<tr>
<td>“Have to do” to if asset heavy or ‘short’ in supply</td>
<td>“Will do” regardless of new area participation</td>
<td>“Should” migrate into depending on role</td>
<td>“Could” evolve into as new business models mature</td>
<td></td>
</tr>
</tbody>
</table>

Key focus areas
- Focus will be directed at ensuring assets are optimized in the market to match price signals
- Focus will move toward achieving the right balance of asset-based and notional transactions within risk parameters
- Focus will address facilitating grid interconnection with other transmission developers
- Focus will also extend to the deployment of technologies or equipment into the distribution network
- Focus will be on enhancing the value of the grid to all stakeholders
- Focus will also address how to leverage technology to enhance system performance and customer engagement
- Focus will be on enabling customers to better leverage behind-the-meter technology
- Focus will also extend to broader engagement with the customer by providing value through advanced data analytics

Future role evolution
Market participants have a range of strategic options to choose from when determining the business model

**Extend the business**
- Regional participation
- Footprint step-out
- Adjacency development

**Monetise the business**
- Investment growth
- Services solutions
- Alliance creation

**Enhance the business**
- Product bundling
- Margin management

**Expand the business**
- Entity acquisition

**Description**
- **Extend the business (Where to play)**
  Growing outside of the core footprint requires enhancing regional market knowledge and more flexible participation models

- **Enhance the business (How to play)**
  Developing attractive customer solutions and improved margins will require broader offerings and tailored prices

- **Expand the business (How to win)**
  Growing the current business will require alliances and/or partnerships with providers and market participants
Players may choose to operate in one or multiple business models across the value chain

Value chain

More integrated

Asset based

Generation

T&D

Retail

Less integrated

Service based

Pure play merchant

Network manager

Grid developer

Gentailer

Value-added enabler

Product innovator

‘Partner of partners’

‘Virtual’ utility

Traditional core business

Pure play merchant

Network manager

Grid developer

Gentailer

Value-added enabler

Product innovator

‘Partner of partners’

‘Virtual’ utility
**Business model options vary based on scope, basis of competition, and source of earnings**

<table>
<thead>
<tr>
<th>Business models</th>
<th>Traditional core business</th>
<th>Gentailer</th>
<th>Pure play merchant</th>
<th>Grid developer</th>
<th>Network manager</th>
<th>Product innovator</th>
<th>“Partner of partners”</th>
<th>Value-added enabler</th>
<th>“Virtual” utility</th>
</tr>
</thead>
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<tr>
<td>Business focus</td>
<td>Assets – customers</td>
<td>Assets – customers</td>
<td>Assets</td>
<td>Assets</td>
<td>Customers</td>
<td>Customers</td>
<td>Customers</td>
<td>Customers</td>
<td>Customers</td>
</tr>
<tr>
<td>Profitability basis</td>
<td>ROIC</td>
<td>Competitive margin</td>
<td>Competitive margin</td>
<td>Regulated ROIC</td>
<td>Regulated ROIC</td>
<td>Competitive margin</td>
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Utilities should select their business model(s) based on future market opportunities and capabilities required ...

<table>
<thead>
<tr>
<th>Description</th>
<th>Capabilities req’d</th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Gentailer</strong></td>
<td>Own generation assets and sell retail energy to customers in a competitive market</td>
<td>• Market insights</td>
<td>Offers electricity and behind-the-meter products such as solar, fuel cells, EV chargers, and smart devices</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Project development</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>• Energy trading/hedging</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Origination, product development &amp; pricing</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>• Customer management</td>
<td></td>
</tr>
<tr>
<td><strong>Pure play merchant</strong></td>
<td>Owns generation assets and sells power into competitive wholesale markets or through bilateral contracts</td>
<td>• Market insights</td>
<td>Offers standard power and gas plus a range of energy services using high quality, branded partnerships</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Project development and finance</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>• Origination</td>
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<td>• Energy trading/hedging</td>
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<tr>
<td></td>
<td></td>
<td>• Risk management</td>
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</tr>
<tr>
<td><strong>Grid developer</strong></td>
<td>Acquires/develops, owns and maintains transmission assets connecting generators to distribution systems</td>
<td>• High voltage line design and operation expertise</td>
<td>Uses core “big data” capabilities to provide enhanced energy services to customers not wanting to actively manage their energy use</td>
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<tr>
<td></td>
<td></td>
<td>• Real-time electricity supply/load mgmt.</td>
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<td></td>
<td></td>
<td>• Stakeholder mgmt.</td>
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<tr>
<td></td>
<td></td>
<td>• Investor relationships</td>
<td></td>
</tr>
<tr>
<td><strong>Network manager</strong></td>
<td>Operates transmission and distribution assets and provides network access to generators and retail service providers</td>
<td>• T&amp;D line design and operation expertise</td>
<td>Aggregates generation from distributed systems and acts as intermediary between/with energy markets without owning generation/T&amp;D assets</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Real-time supply/load mgmt. and central/DG resource integration</td>
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<td>• System data analytics</td>
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</table>
... and determine **how to leverage their strengths to enhance their future competitive positioning**

**Business Model Levers**

- **Data**: Ownership of grid and customer information can provide a knowledge platform that enhances the value proposition
- **Policy**: Mandates and legislation can shape the playing field and enhance the incumbent’s ability to compete
- **Relationships**: The natural interfaces of the incumbent with customers, suppliers, stakeholders and other providers creates a natural platform
- **Pricing**: Shifts in traditional cost recognition models can provide greater certainty to cost recovery and additional flexibility to rate design
- **Partnering**: Enhanced creative and delivery capabilities can extend the incumbent’s existing platforms and market “reach”
- **Regulatory**: Decisions can provide both offensive (exploit) and defensive (preserve) mechanisms to enhance market competitiveness
Our four step approach can help you with your strategic decision making

1. **What markets will emerge**
   - Identify most likely emerging markets
   - Analyse the likely impact of emerging market models and value pools

2. **Where do we play?**
   - Identify future business models
   - Estimate size of future value pools
   - Develop scenarios for different roles and play vectors

3. **How do we play?**
   - Analyse strategic business model dimensions
   - Enable strategic business model decisions

4. **How do we win?**
   - Capability development
   - Operating model design
   - M&A activity and development partnerships
   - Invest in regulatory debate
   - Develop financing plan and analyse impact on credit rating
   - Plan culture change management programme

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PwC as your partner in realising change

- We can support in driving the strategy process and conduct in depth analysis.
- We can help you achieve optimal implementation of strategic decisions and clear measurement of success.

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Strictly private and confidential
Global Energy Transformation • Challenges and solutions for the power sector
PwC
Thank you!!