

THE COMMERCIALISATION OF FLEXIBILITY FROM THE DEMAND SIDE

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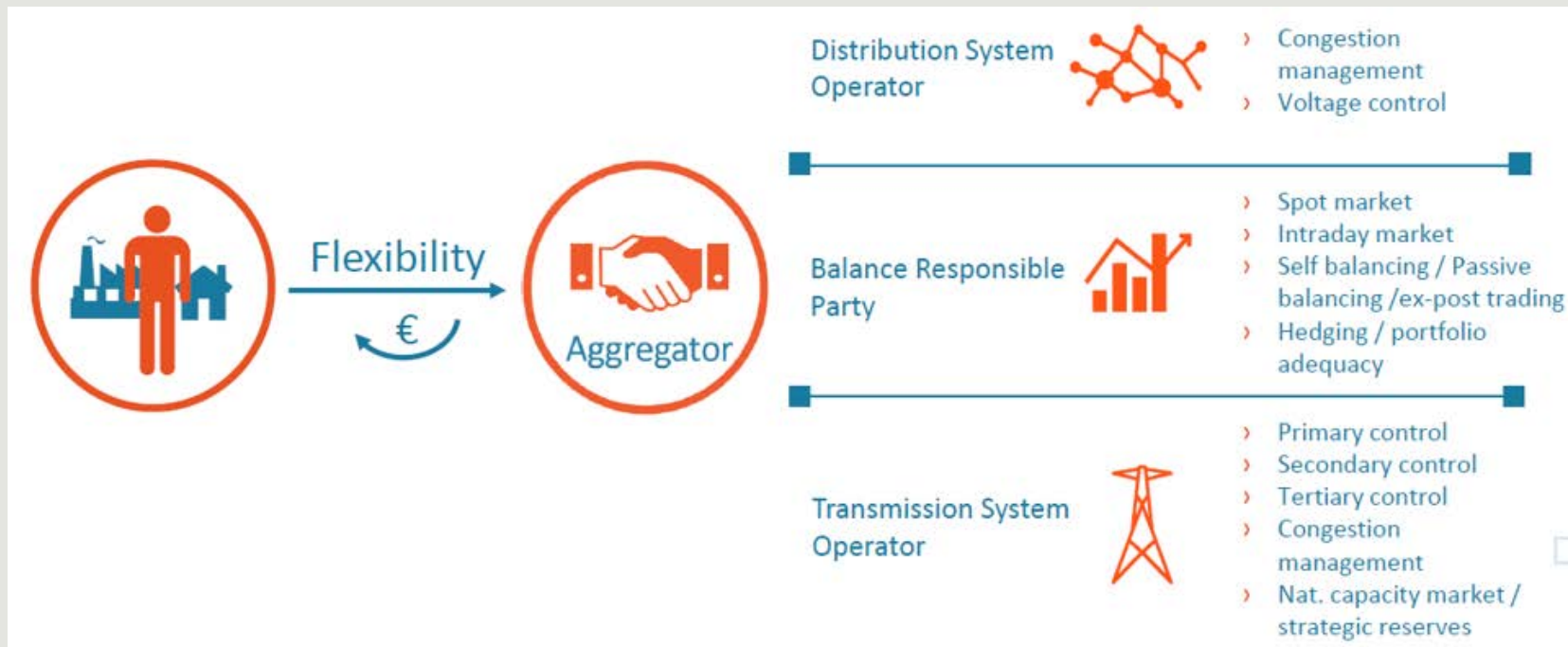
Flexibility potential – What is out there?

2020+ scenarios

- An analysis by Association for Decentralised Energy found that the total amount of potential DSR in the UK in 2020 can be conservatively estimated at **9.8 GW**. This estimate includes:
 - 2.8 GW from industrial demand flexibility
 - 1.7 GW from commercial and public sector demand flexibility
- Agora Energiewende's Smart Markets study estimates the demand-side potential in DE in 2025 to around **30 GW**
- The European Commission estimates the theoretical potential at **100 GW** in 2020 and 160 GW in 2030
 - 2020 potential mainly from residential consumers
 - 2030 estimate driven by new flexible loads such as electric vehicles and heat pumps.
 - App. 30-40% can be considered technical and economic potential if market arrangements are in place

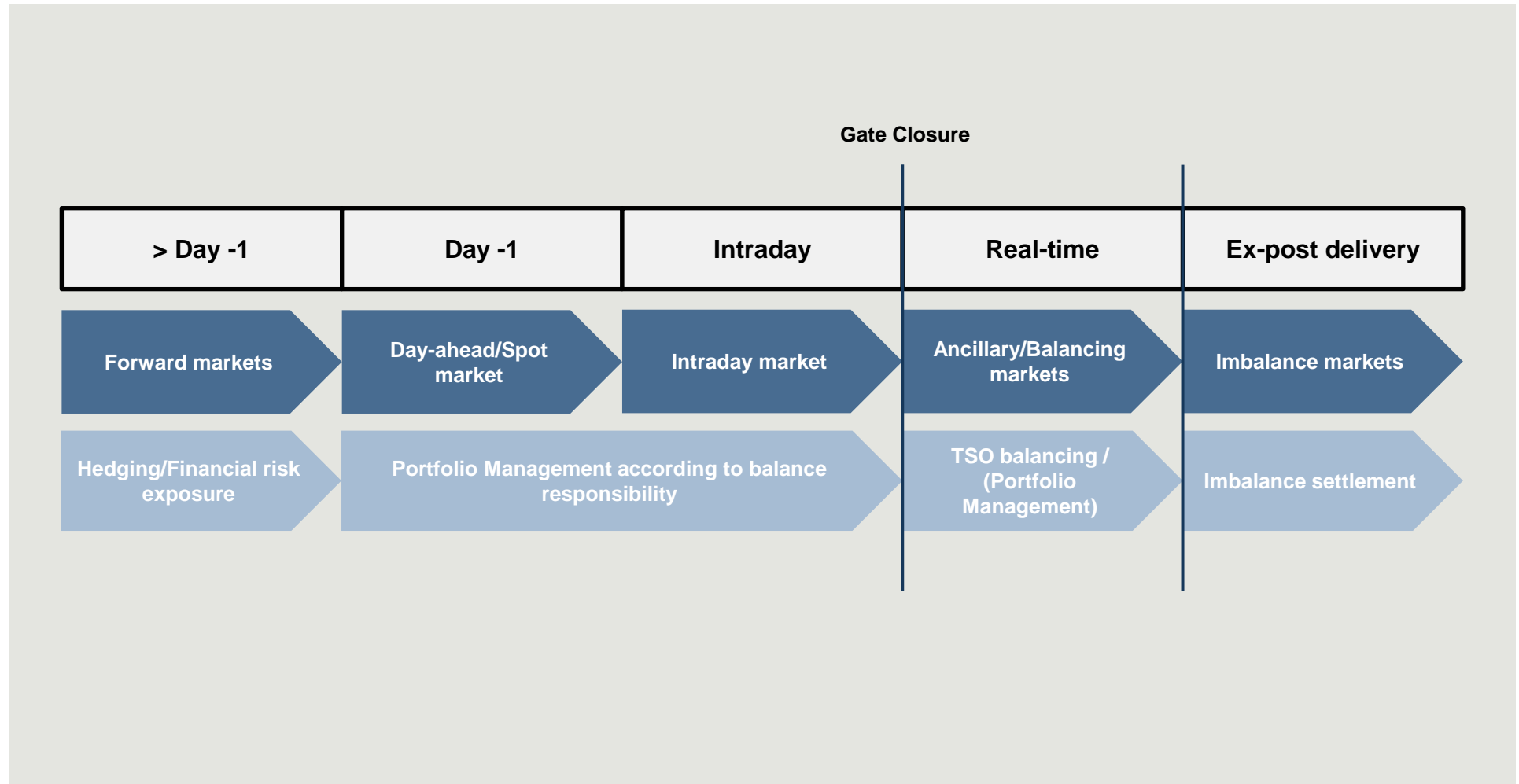
The flexibility value chain

Involving all relevant stakeholders



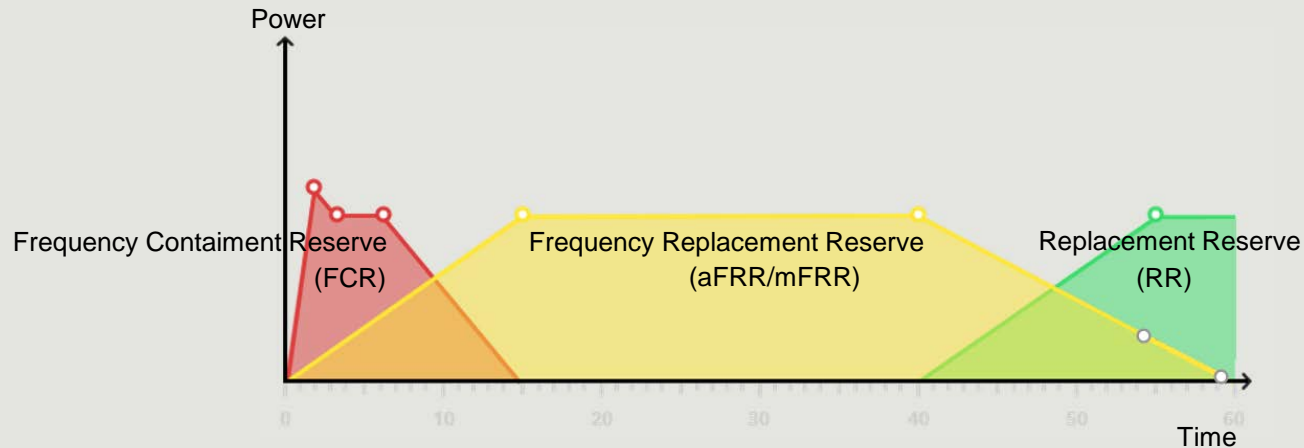
General market design philosophy

Energy and balancing markets



Ancillary Services Markets

How TSO's balance the system with reserves – Case Denmark and Great Britain

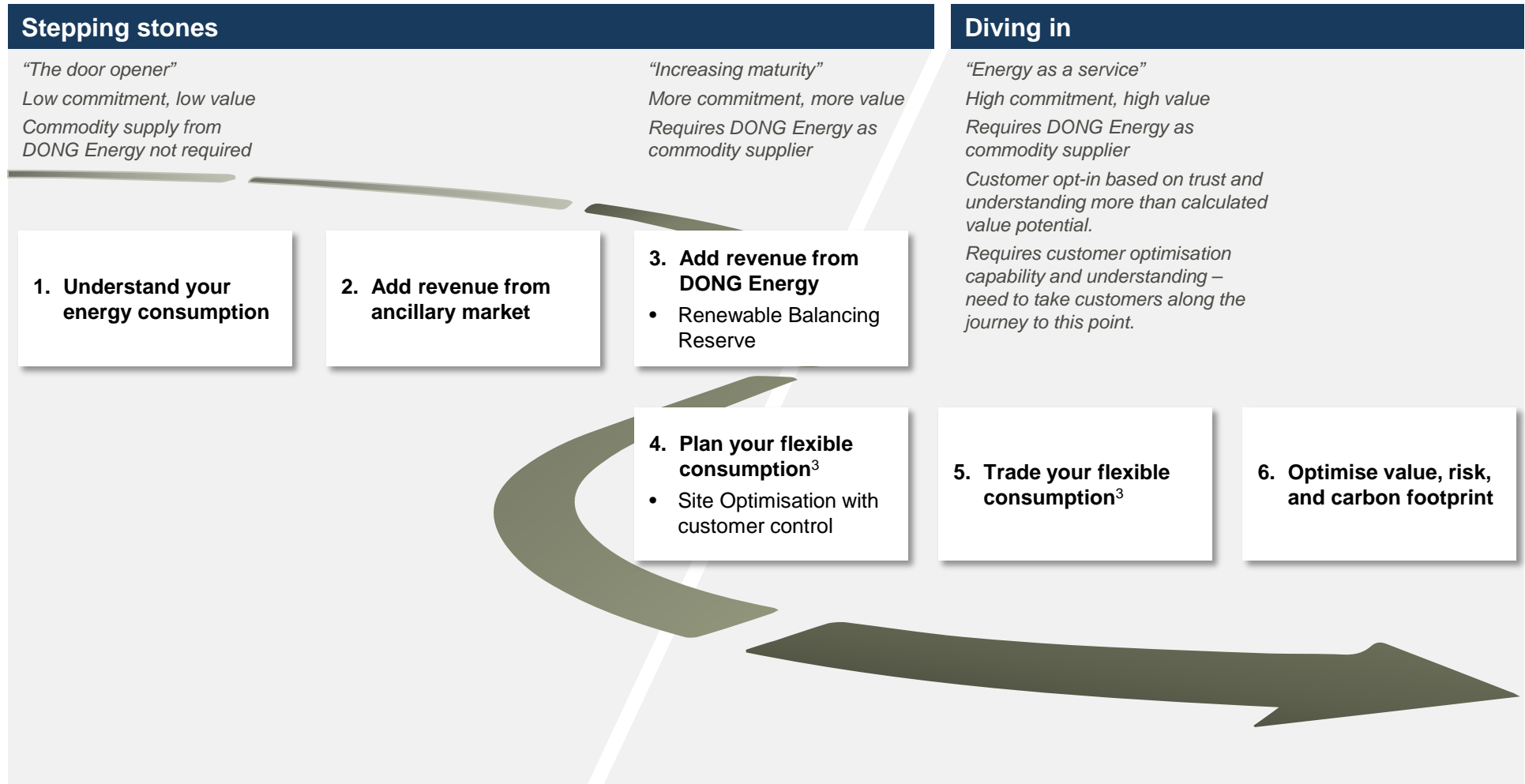


European terminology	National terminology (DK1)	Contracted volume	Others
FCR	Primary Reserve	~22 MW	Min. Bid Size: 0,3 MW
aFRR	Secondary Reserve	~100 MW	Min. Bid Size: 1 MW
mFRR	Tertiary Reserve / Regulerkraft CMO	~870 MW	Min. Bid Size: 10 MW

European terminology	National terminology (GB)	Contracted volume	Others
FCR	Firm Frequency Response	~180 MW	Different response sub-requirements
FCR	Enhanced Frequency Response	~ 200 MW	Sub-second response – designed for batteries
FCR	Frequency Control by Demand Management	N/A	Bilateral agreements only
FRR	Fast Reserve	~2400 MW	
RR	Short-Term Operating Reserve	~3000 MW	Oversubscribed and very competitive
RR	Demand Side Balancing Reserve	~300 MW	Phased out from winter 16/17

The customer journey begins with low commitment solutions

The future of flexibility product development



[1] Typical asset size is 3 MW

[2] Typical power consumption and/or generation is 25 GWh per year

[3] Consumption and embedded generation

Demand contributes to system stability and security of supply

Case study from the Faroe Islands

- Large industrial customers in Faroe Islands providing sub second FFDR (Fast Frequency Demand Response) for the system operator SEV
- Incentive is security of supply, mitigating risk of losing embryonic fish stock, etc.
- Part of the Micro Grid energy management system

Kollafjord Pelagic

Receives freshly caught fish and freeze it. The facility in Kollafjørð is one of the world's largest and most advanced processing facilities for human-consumption pelagic fish.

(4200 kW cooling compressors)



- Cloud-based system planning and scheduling performed by Power Hub central optimisation engine
- Response activation done locally on site by Remote Terminal Units with embedded Power Hub intelligence
- Faroese system operator, SEV, documented at least 4 prevented black outs in 2014 by activating FFDR

Introducing Renewable Balancing Reserve in the UK

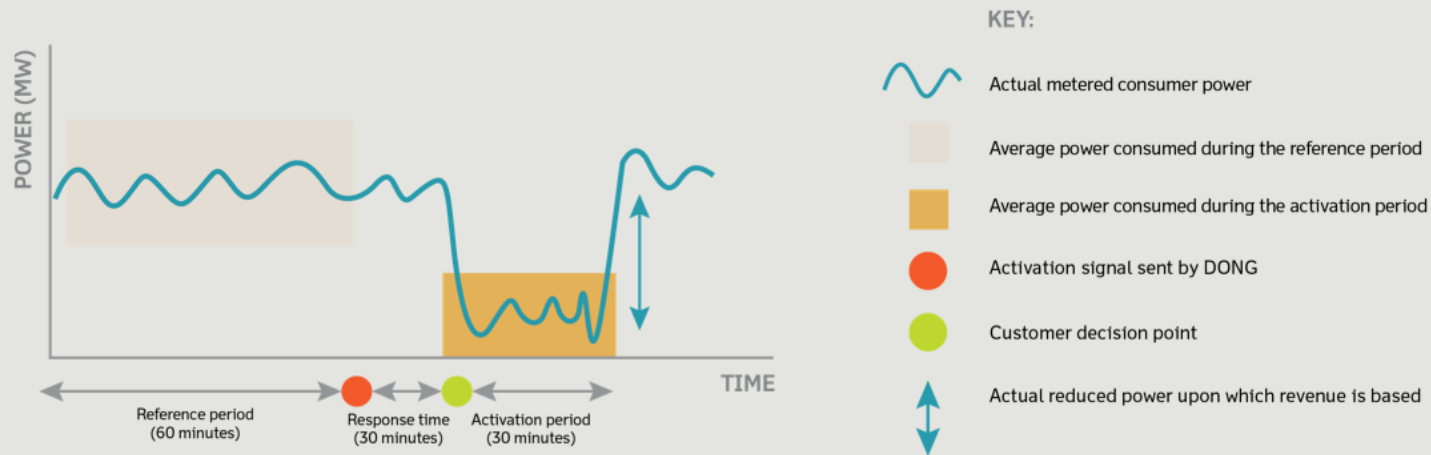
Offering flexibility products to the customers



Renewable Balancing Reserve is a new demand management scheme that enables DONG Energy customers to build a new revenue stream, by taking a share of our reduced system balancing costs



By reducing consumption or switching to onsite generation when requested by DONG, you can help us to balance intermittent renewable generation whilst earning revenue for every MWh you haven't taken in supply



Renewable Balancing Reserve

How does it work?

Renewable Balancing Reserve operates via an online portal, which is very simple to set-up and use:

Set the times in which you can participate, and the minimum price you are willing to accept

We alert you the times to reduce your consumption, and the revenue available to you

You confirm whether you are able to participate during these times

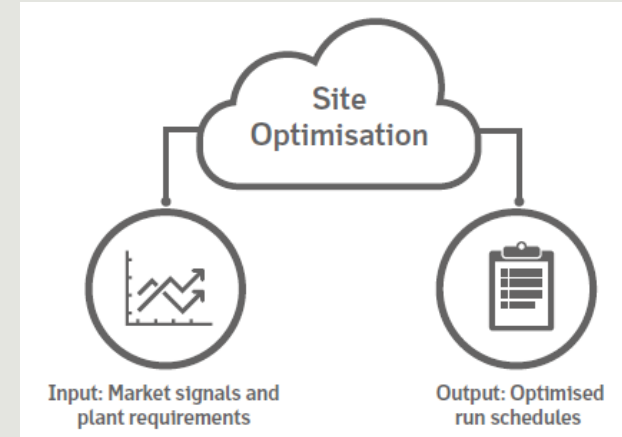
You receive payment according to the actual consumption and imbalance price



Site Optimization

Asset operation guideline to lower the overall energy cost

- Cloud based solution to calculate the optimal run schedule for an operating plant
- Analysis of market signals, such as wholesale energy prices, in relation to operating constraints and asset availability
- Day-ahead (5 days ahead) run schedules that are optimised towards the half-hourly forecasted spark spread

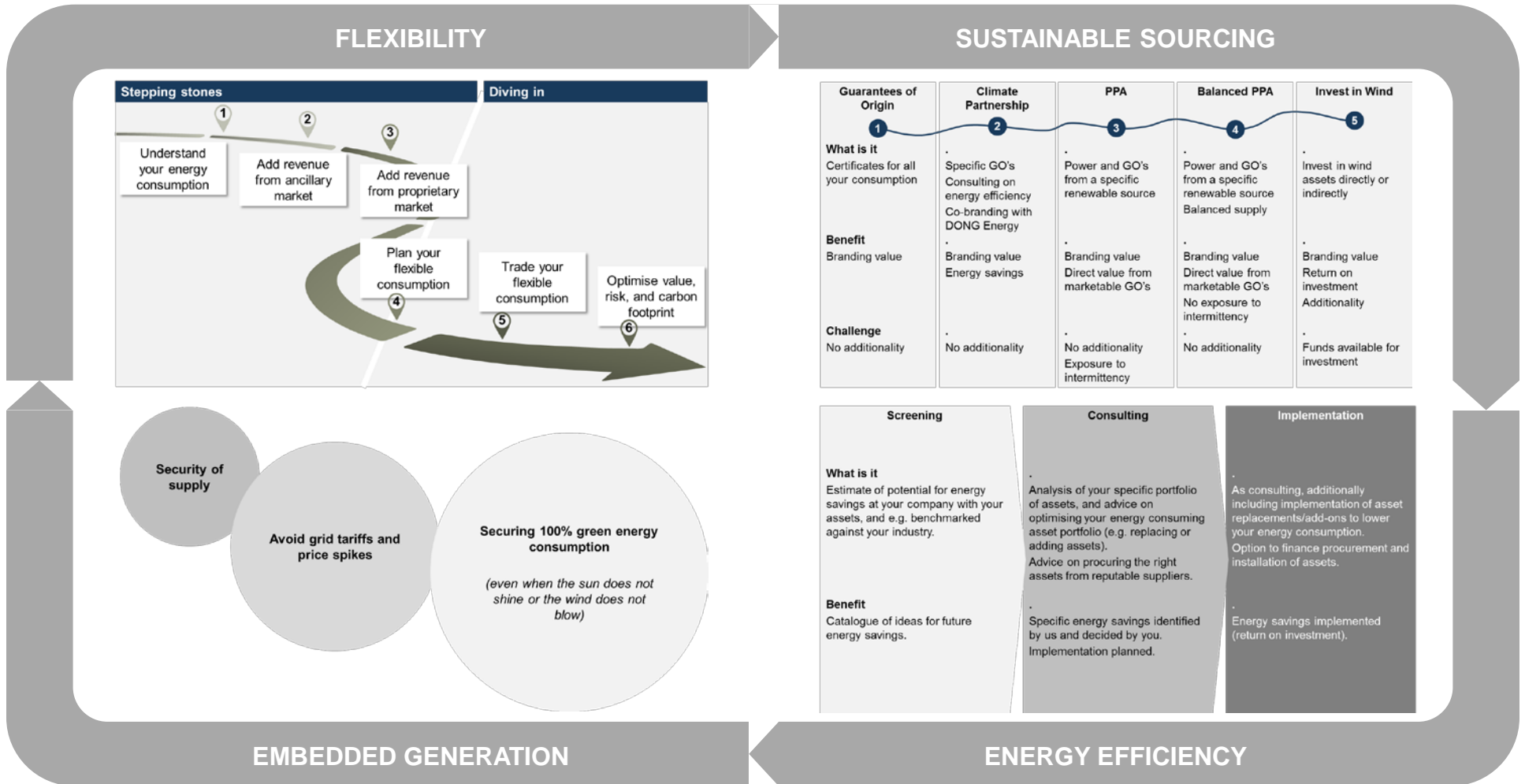


Kodak alaris

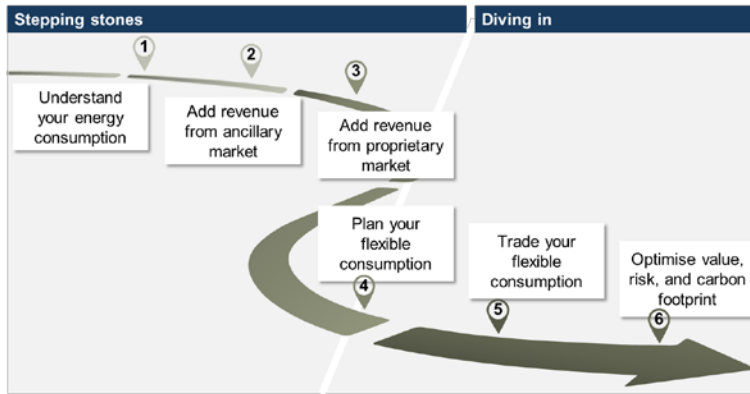
- Kodak Alaris manufactures photographic and imaging equipment
- Need for a strategy that used generation and consumption assets in the most efficient way to reduce energy costs
- 11% saving in energy costs as well as increase in operational performance

Energy as a Service – A new business area

Several customer offerings compiled into one journey



FLEXIBILITY



SUSTAINABLE SOURCING

1	2	3	4	5
Guarantees of Origin	Climate Partnership	PPA	Balanced PPA	Invest in Wind
What is it Certificates for all your consumption	Specific GO's Consulting on energy efficiency Co-branding with DONG Energy	Power and GO's from a specific renewable source	Power and GO's from a specific renewable source Balanced supply	Invest in wind assets directly or indirectly
Benefit Branding value	Branding value Energy savings	Branding value Direct value from marketable GO's	Branding value Direct value from marketable GO's No exposure to intermittency	Branding value Return on investment Additionality
Challenge No additionality	No additionality	No additionality Exposure to intermittency	No additionality	Funds available for investment



EMBEDDED GENERATION

ENERGY EFFICIENCY

Screening	Consulting	Implementation
What is it Estimate of potential for energy savings at your company with your assets, and e.g. benchmarked against your industry.	Analysis of your specific portfolio of assets, and advice on optimising your energy consuming asset portfolio (e.g. replacing or adding assets). Advice on procuring the right assets from reputable suppliers.	As consulting, additionally including implementation of asset replacements/add-ons to lower your energy consumption. Option to finance procurement and installation of assets.
Benefit Catalogue of ideas for future energy savings.	Specific energy savings identified by us and decided by you. Implementation planned.	Energy savings implemented (return on investment).

Thank you!

Backup

Dong Energy's aggregator platform Power Hub

How to manage flexibility by aggregation

- Combining physical, financial and contractual optimisation
- Planning and scheduling up to 5 days ahead
- Energy trading and reserves activation within day of operation is also done

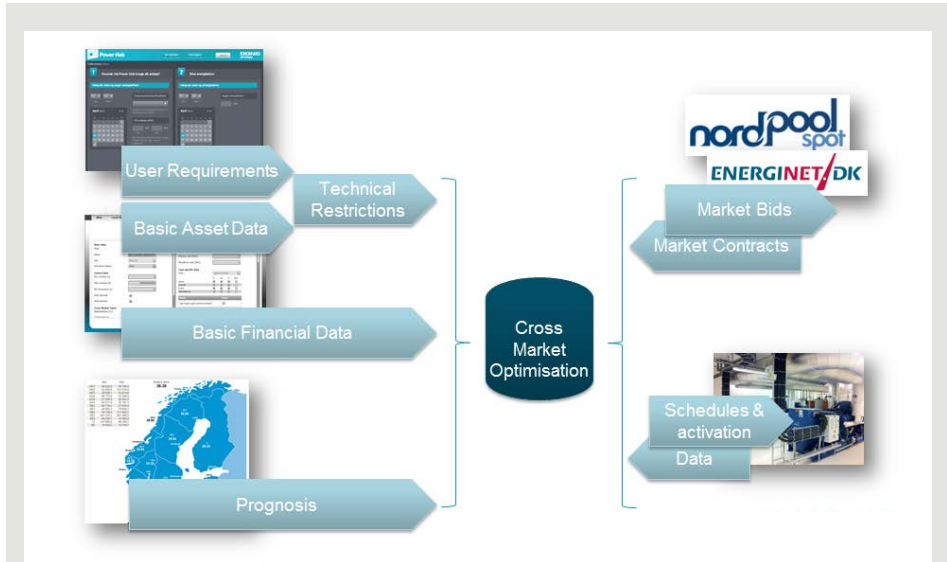
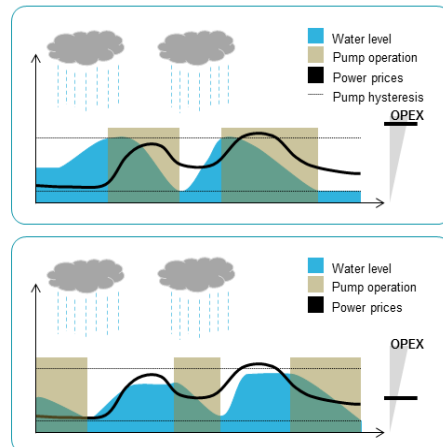
TRADITIONAL PUMPING FACILITY CONTROL SCHEME: hysteresis based

- Convenient (easy to understand)
- Reactive measures
- OPEX sensitive to fluctuating power prices



VPP INTEGRATED PUMPING FACILITY

- Price optimal and predictive
- Proactive measures
- OPEX reduction due to fluctuating power prices



- IT system run on site or as a cloud-based service
- Control system integration and require a robust communication infrastructure may be needed
- Power Hub links the customer to the energy and reserve markets

Clarity is needed to enable the full potential of flexibility

The challenges to enable the full potential of demand side flexibility are not technical

- The business case is not good in most cases
- Many regulatory barriers are identified and addressed by policy makers in their market reform initiatives

Implementation of measures proposed in the market reforms

- Market Reforms in UK, DE, DK etc
- EU Winter Package and Balancing GL
- Facilitate independent aggregation

Standardized role model

- Standardized business processes and contracts e.g. USEF
- Facilitation of harmonized markets

The role of the DSO

- Encourage use of flexibility on market terms to solve congestions
- Review network tariff structure



Improved business case

- New products and services to the customer
- Less risks for the strategic business case due to more regulatory stability
- Liquid markets for flexibility (e.g. intraday)

Barriers for integrating Demand Response

Challenges in existing market design

Relationship between market players

- Streamlined contractual and process setup between customer, supplier, aggregator, BRP, TSO and DSO
- Ensure transparency and privacy
- Fair transfer of energy and financial risks

A one size fits all solution for all countries seems not feasible

- Industry and customer segments with different profiles
- Joint approach is needed to ensure a certain compatibility of national models
- Different national interests and regulation

Adequate measurement and verification methodologies

- Appropriate metering and sub-metering setup
- Baseline methodologies

Market access

- Technology agnostic product requirements
- Review markets in terms of bid size, duration and gate closure
- TSO approval of an aggregator's portfolio as a single unit

Renewable Balancing Reserve

How does RBR compare with other demand side schemes?

	Commitment free	Notice period	Ease of participation	Volume restrictions	Penalty free	Scheme availability
National Grid Demand Side Balancing Reserve	✗	2 hrs	Formal bid process	Restricted	✗	Peak demand only
Capacity Market Demand Side Response	✗	2 hrs	Formal bid process	Restricted	✗	Peak demand only
DECC Electricity Demand Reduction	✗	N/A	Formal bid process	Restricted	✗	Peak demand only
Short Term Operating Reserve (STOR)	✓	Up to 4 hrs	Formal bid process	Restricted	✗	Peak demand only
DONG Energy Renewable Reserve	✓	5 mins – 50 mins	Fully flexible: participate when you wish	No restrictions	✓	Throughout the year

Renewable Balancing Reserve uniquely provides a commitment and penalty-free opportunity, that is available all year round