Cost-Benefit Analysis of the Fenix Concept

Financial and socio-economic impacts of the FENIX VPP Concept – General approach and applications to the Northern Scenario

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Outline

- Objectives and approach
- FENIX VPP concepts
- CVPP cases for Northern Scenario
- Results cost-benefit analysis for CVPP
- Impact on society level
- Summary and conclusions

Objective

To demonstrate the economic viability of the
FENIX VPP Concepts

- Prove the ***economic value*** of flexible DG operations
- Demonstrate that existing and new ***business models can profit from this economic value***

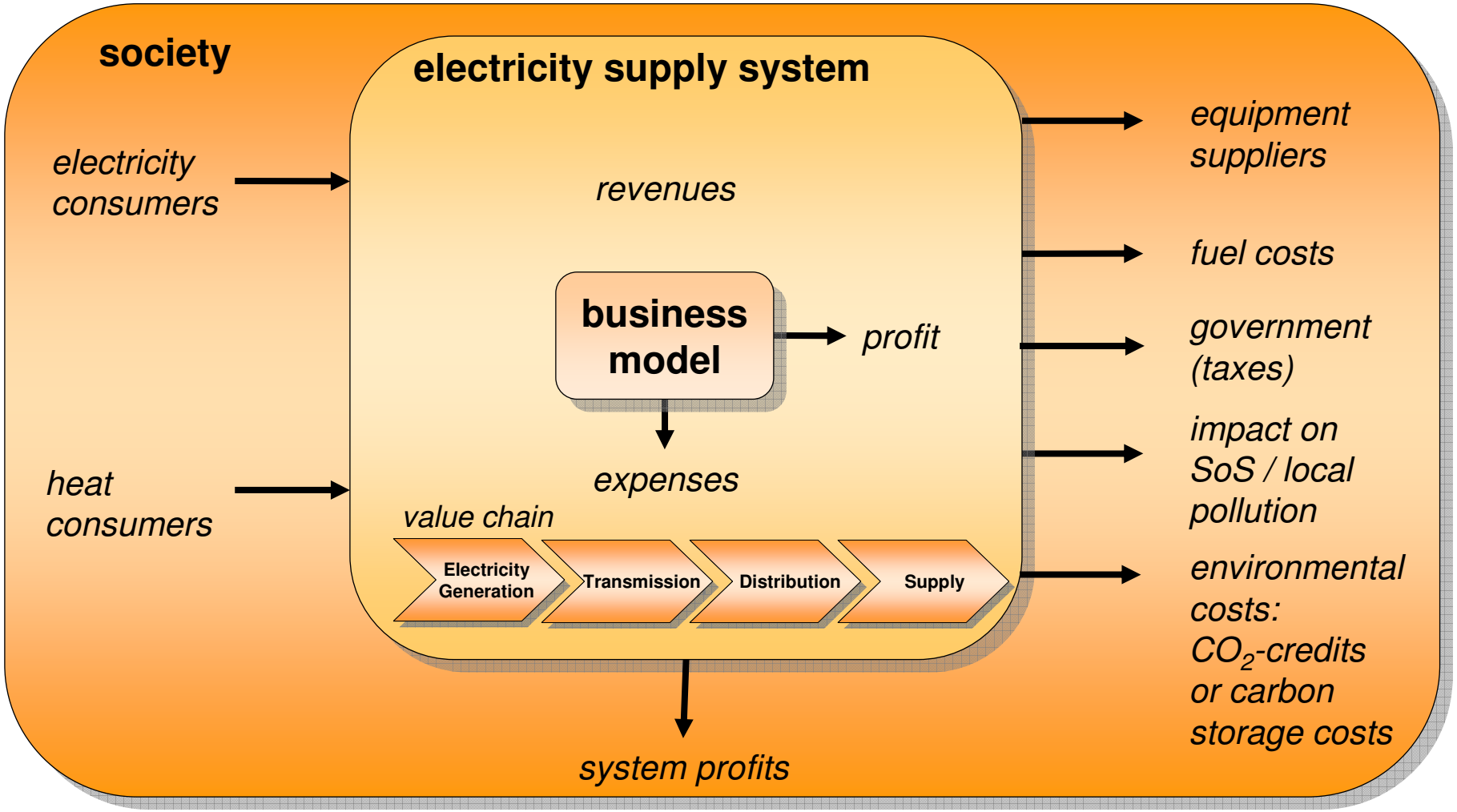
Approach

- Concrete VPP cases in ***Northern (Woking)*** and ***Southern (Alava)*** ***scenarios***
- Demonstration based on ***simulation of the financial flows*** between business actors in the electricity market
- ***Cost-benefit analysis***
  - Focus on ***incremental changes*** in recurrent cash-flows
- ***Results***
  - Net benefits for ***stakeholders and society*** as a whole
  - Small scale application ***current market conditions***
  - Small scale application ***future market conditions*** (2020)
  - ***Impact of scale-up*** of Fenix concept under future market conditions (2020)

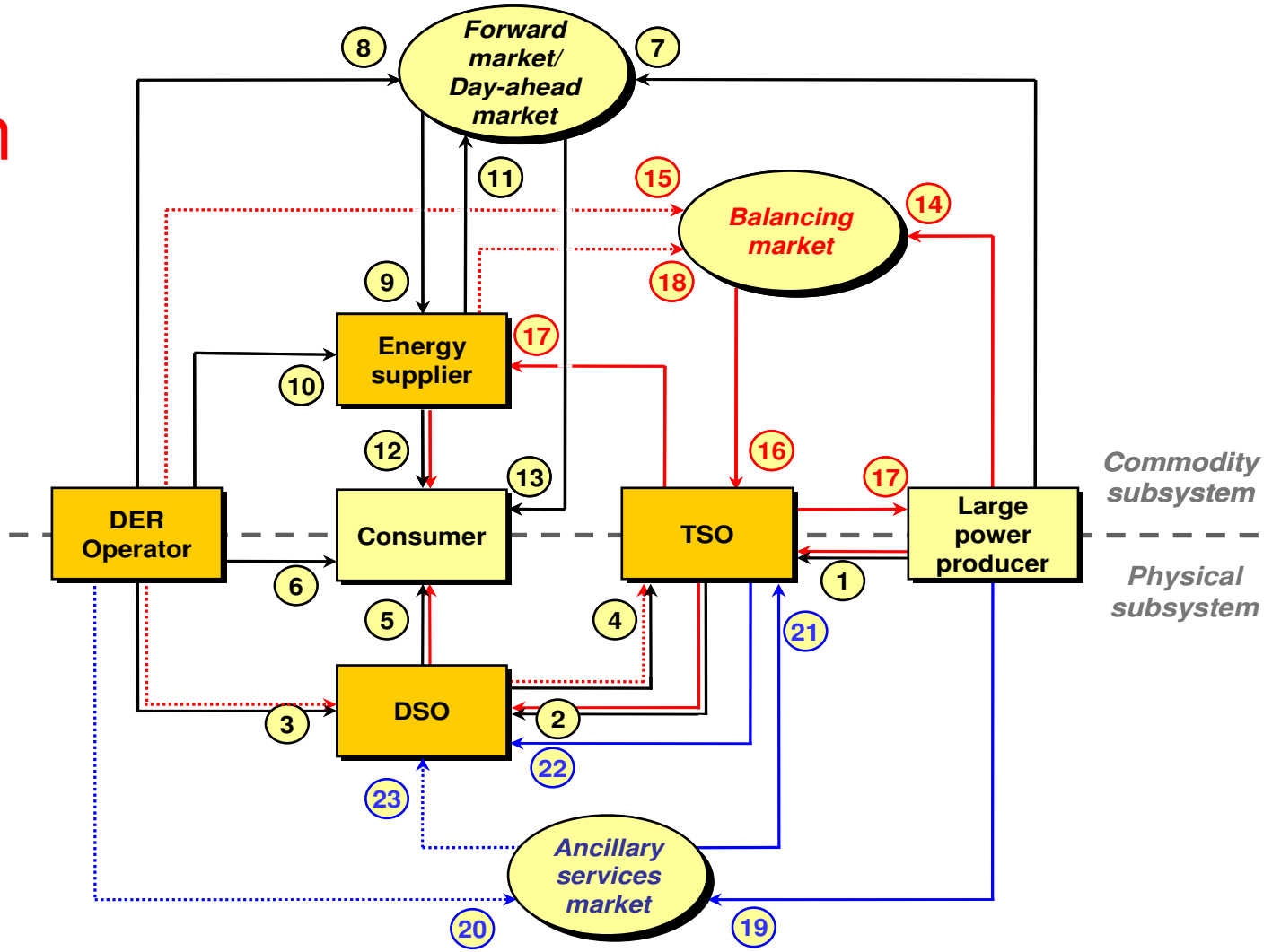
FENIX VPP Concept – Economic value

- ***Commercial Virtual Power Plant (CVPP)***
  - Introduce flexible DER operations
  - Responsive to market price signals or (internal) balancing incentives
  - ***Economic value:*** flexible DER is more competitive
- ***Technical Virtual Power Plant (TVPP)***
  - Reducing network operational expenditures (e.g. energy losses, reactive power costs)
  - DER replacing or postponing network reinforcement investments
  - Flexible operations of DER supporting network congestion management
  - ***Economic value:*** flexible DER operations reduces operational costs and avoids network investments

Levels and system boundaries



Northern Scenario: Transaction Scheme



Arrows represent exchanges/transactions between different parties of the electricity supply chain.

Northern Scenario

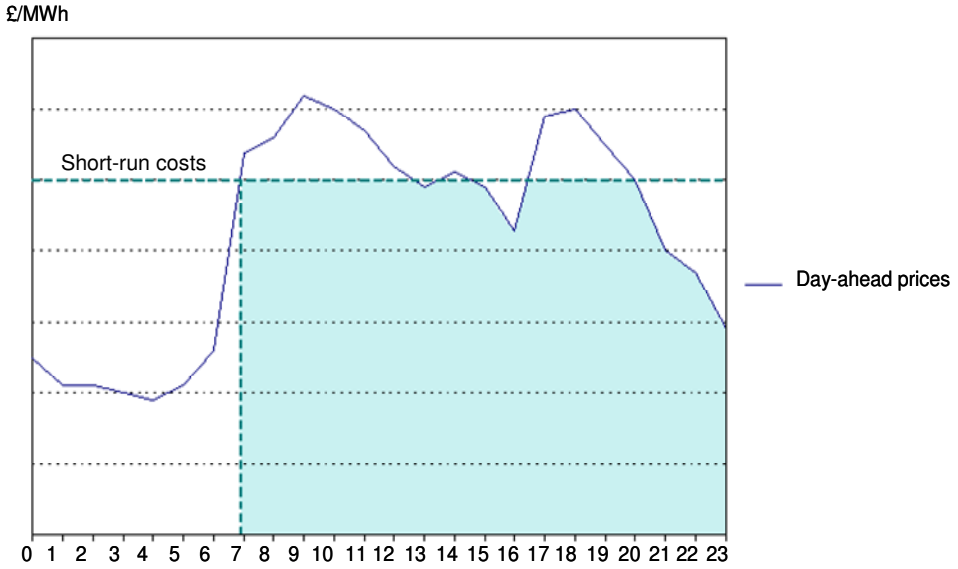
Case Studies and Scenarios

Case Study	Northern Scenario (Woking)
Ref.	***Fixed generation profiles***
1	Optimised ***wholesale market participation***
2	***Balancing services*** to the Transmission System Operator
3	***Intra-day balancing service*** to the energy supplier
4	***Tertiary reserve service*** to the Transmission System Operator

Northern Scenario

Reference Case

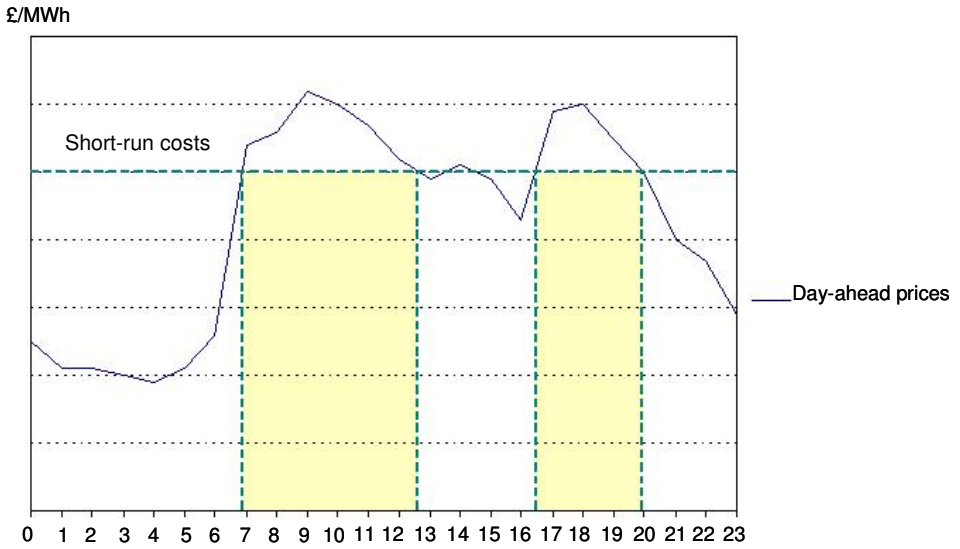
- CVPP is operating as an Aggregator
  - DER operation ***is not optimized*** with respect to Day Ahead market prices
  - Pre-determined production profile
  - CVPP (Aggregator) role is limited to aggregating production for market access and proceeding transactions



Northern Scenario

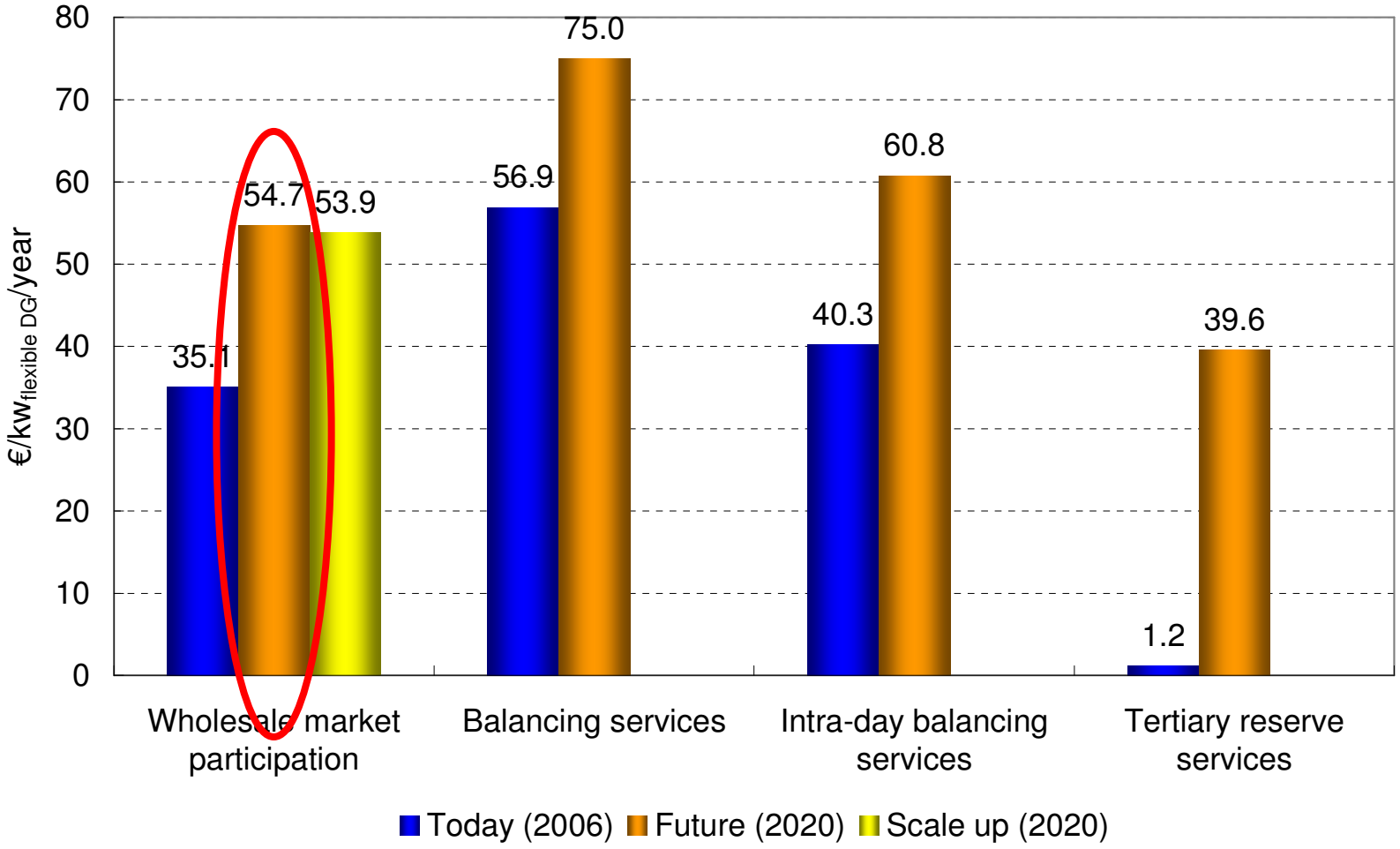
Optimized wholesale market participation

- ***CVPP optimizes DER operation*** with respect to wholesale power market
  - CVPP forms bids for Day Ahead Market, regarding operational parameters of DERs, local heat demand, etc.
  - If bids lower than observed Day Ahead prices, DERs deliver power
- ***CHPs coupled with thermal store*** to exploit whole range of flexibility
  - Effective electric efficiency is used for useful heat production



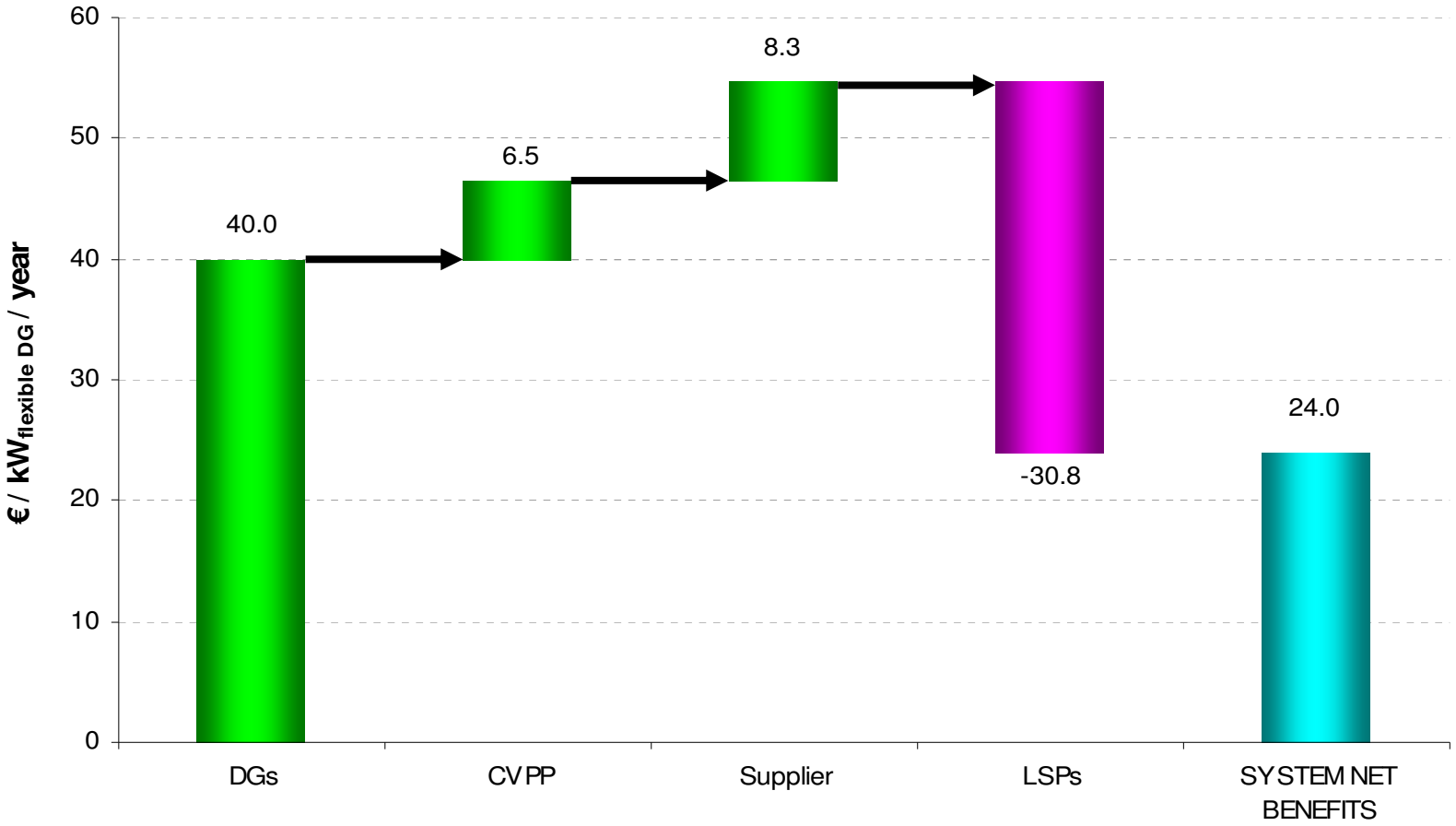
Northern Scenario

Aggregated net-benefits for business stakeholders



Northern Scenario – Optimized wholesale market participation 2020

Distribution of net-benefits over stakeholders



Impacts on society level

- ***Fuel consumption decreases***
  - Northern Scenario (large scale): -0.2%
  - Reduction greenhouse gas emissions
    Northern Scenario: 7.5 kg CO_2/$kW_{flexible\ DG}$/year
  - Positive impact on gas supply security
- ***Improving intermittent RES integration***
  - More flexible power generation available
- ***Potential for lower electricity end-user prices***
  - Improved market competition

Conclusions

- **Economic added value for CVPP**
  - Quantitative economic simulations and cost-benefit analyses indicate ***positive results on system level and for DG owners***
    - Under present conditions
    - Under future conditions, also if FENIX concept is scaled up
  - Quantitative economic analysis show ***positive impact for society***
    - Lower fuel consumption, resulting in GHG reduction
    - Improvement intermittent RES integration
    - Potential for lower electricity end-user prices
- Economic benefits will only be realised with an ***adequate regulatory and contractual framework*** in place.

Thank you for your attention!

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http://www.fenix-project.org