PROFITABILITY EVALUATION OF INTRODUCTION OF V2G – ENABLED FCR SERVICES INTO THE BUSINESS MODEL OF A CPO

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OBJECTIVES OF THE STUDY

How does the participation in V2G-enabled grid balancing services influence the profitability of a CPO?

- Qualitative conceptualization
- Quantitative framework
- Evaluation through profitability indicators

EV CHARGING BUSINESS ECOSYSTEM

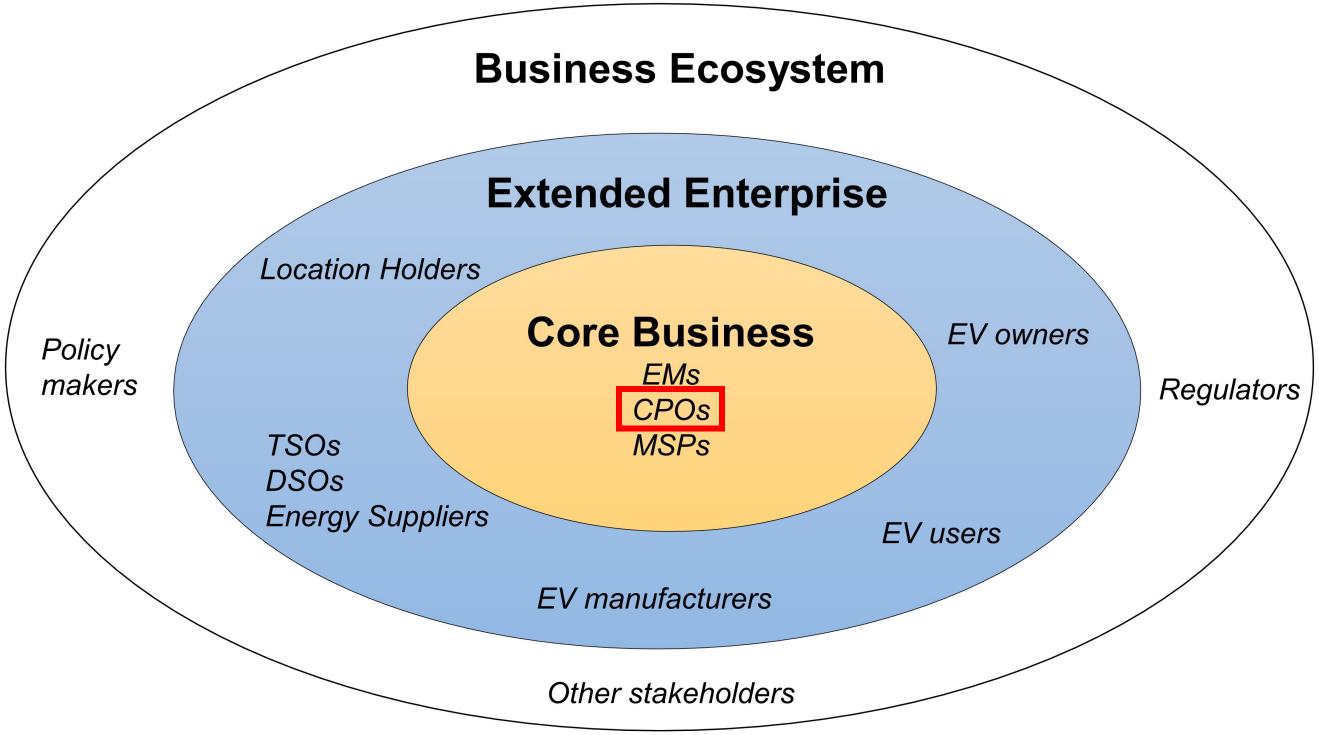


Figure 1: EV charging business ecosystem [1]

CPO BUSINESS MODEL

Key Partnerships

- RSPs
- DSO
- Regulators
- EMs
- Energy Suppliers

Key Activities

- Purchase, installation and management of EVCPs
- R&D
- Technical and customer support and repair
- Provision of online EVCP troubleshooting and support

Key Resources

- Network of managed EVCPs
- IT platform for EVCP management
- HR with specific skills

Value Propositions

- Connection to CPO controlled network of EVCPs
- EVCPs management and maintenance (M&M) services
- Provision of access to charging data
- Installation of EVCPs
- Technical services
- Provision of direct charging access to EVCPs

Customer Relationships

- Automated: perfect scenario
- Personalized: in case of issues

Channels

- Company representatives
- Network of managed EVCPs
- Website, email, telephone, social networks

Customer Segments

- MSPs
- EV users:
  - *EV users with MSP subscription*
  - *EV users with no MSP subscription*
- Location holders and owners of EVCP network

Cost Structure

- HR costs (salary etc.)
- EVCPs M&M costs
- Supplied electricity fees
- R&D costs
- EVCPs purchase and depreciation costs

Revenue Streams

- CPO fees
- Charging fees for direct charging of EV users without MSP subscription
- Installation, technical services and customer support fees

Figure 2: CPO business model [1]

INTRODUCTION OF V2G INTO CPO BUSINESS MODEL

Key Partnerships

- DSO
- TSO
- Regulators
- Equipment manufacturers
- Energy Suppliers
- EV users

Key Activities

- Purchase, installation and management G2V/V2G EV charge points
- Grid balancing activities
- R&D
- Technical and customer support and repair
- Provision of online troubleshooting and support

Key Resources

- Network of managed of G2V /V2G EV charge points
- IT platform for G2V/V2G charge points management
- HR with specific skills

Value Propositions

- Connection to CPO controlled network of G2V/V2G EV charge points
- G2V/V2G EV charge points M&M services
- Access to charging and discharging data
- Installation of G2V/V2G EV charge points
- Technical services
- Provision of direct connection to G2V/V2G EV charge points
- Grid balancing services

Customer Relationships

- Automated: perfect scenario
- Personalized: in case of issues

Channels

- Company representatives
- Network of managed G2V/V2G EV charge points
- Website, email, telephone, social networks

Customer Segments

- MSPs
- EV users:
  - *EV users with MSP subscription*
  - *EV users with no MSP subscription*
- Location holders and owners of EV charge points network
- DSOs
- TSOs

Cost Structure

- HR costs
- G2V/V2G EV charge points purchase, depreciation and M&M costs
- Supplied electricity fees
- R&D costs

Revenue Streams

- Charging fees
- Other revenues (e.g., installation, technical services fees etc.)
- Grid balancing services revenues

Figure 3: CPO business model after the introduction of V2G technology (changes marked in blue) [1]

TYPES OF FLEXIBILITY SERVICES [2]

Type	Description
Frequency Containment Reserve (FCR)	Primary automatic reserve provided by the Balancing Service Provider (BSP) with FCR service contract, reacting within the timeframe between 0 and 30 seconds to a frequency deviation, covering a period of at least 15 minutes per incident and stabilizing frequency on a certain level.
Automatic Frequency Restoration Reserve (aFRR)	Secondary automatic reserve provided by the BSPs with aFRR service contract, restoring the frequency to 50 Hz. The requested energy is to be activated within the time frame of 30 seconds to 7.5 minutes (Elia plans to move to 5 minutes by 2025) and cover a period of at least 15 minutes after the full activation.
Manual Frequency Restoration Reserve (mFRR)	Tertiary reserve, provided by the BSPs with mFRR service contract, manually activated by the TSO in case of major imbalances and congestions, restoring the frequency to 50 Hz. The respective BSPs must make mFRR available not later than 15 minutes after the TSO's demand. The maximum active period is not defined, as the reserve should be active until the problem is solved.

FREQUENCY CONTAINMENT RESERVE (FCR)

- EV batteries to react immediately to a power request [3-4]
- Relative readiness of the TSOs and policy makers to adopt FCR service conditions for smaller decentralized BSPs [3-4]
- The only remuneration foreseen for FCR services is based on the energy capacity offered by the BSP and reserved by the TSO, expressed in €/MW/h price [5].
- The potential financial penalty cannot exceed the remuneration [5].

METHODOLOGY

V2G-ENABLED FCR SERVICES INTO THE FINANCIAL PERSPECTIVE OF THE CPO BUSINESS MODEL

$$Costs_{CPO} = C_{Infrastructure} + C_{Electricity} + C_{MP} + C_{HR} + C_{Other}$$

- $C_{Infrastructure}$: depreciation, management and maintenance costs of EVSE infrastructure.
- $C_{Electricity}$: electricity costs paid to the energy suppliers
- C_{MP} : costs for accessing the common marketplace for EV charging business ecosystem.
- C_{HR} : costs related to the human resources.
- C_{Other} : other additional costs, not represented by the previous categories.

$$Revenues_{CPO} = TF_{CPO} + OR_{CPO} + R_{FCR}$$

- TF_{CPO} : total fee received from the charging activities on the CPO EVSE network.
- OR_{CPO} : other revenues generated by side activities not directly related to the EV charging (e.g., installation, technical fees, etc.).
- R_{FCR} : revenues generated through FCR flexibility services for DSO/TSO

$$R_{FCR} = FCR_{Bid} * \sum_{y=1}^{Z}(K_y * N_y * (CR_y - UR_y)) * T$$

- FCR_{Bid} : average FCR capacity bid (in €/MW/h) during the considered time period (T) on the energy capacity auction organized by the TSO.
- y: type of EVSE (e.g. unidirectional, V2G)
- K_y : power level of (V2G) EVSE type y
- N_y: number of EVSE type y
- CR_y : connection rate (in %) of EVSE, being the percentage of the considered time period (T) that the considered EVSE type y was connected to an EV.
- UR_y : usage rate (in %) of EVSE, being the percentage of the considered time period (T) that the considered EVSE type y was actually engaged into the EV charging process.
- T: considered EVSE availability time period

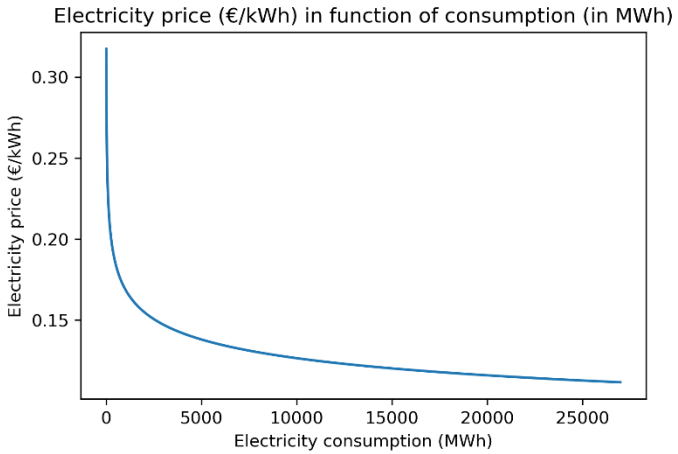
METHODOLOGY

PROFITABILITY INDICATORS

Indicator		Generalized formula	Definition
EBIT	=	$Revenues - Costs$	EBIT is the difference between company's operating revenues (not including the interest revenues) and costs (before the inclusion of tax-related expenses) [13] [14].
EBITDA	=	$EBIT + Depreciation + Amortization$	EBITDA repeats the definition of EBIT, but not including the depreciation and amortization into the costs list [13] [14].
EBIT margin (%)	=	$\frac{EBIT}{Revenue} * 100\%$	EBIT margin is a company profitability ratio, indicating the relative part of the revenues preserved after the deduction of expenses (before interests and taxes) [15].
EBITDA margin (%)	=	$\frac{EBITDA}{Revenue} * 100\%$	EBITDA margin repeats the definition of EBIT margin, but not considering the depreciation and amortization costs [15].
ROI (%)	=	$\frac{EBIT}{Total\ investment} * 100\%$	ROI shows the ratio of company's EBIT to the total amount of the invested capital [15].

ASSUMPTIONS

VALUES OF THE SELECTED PARAMETERS



Parameter	Symbol	Unit	Value	
EVSE type	y		11 kW AC	V2G 11 kW DC
EVSE price [6-9]	P_y	€	1200	5000 3999 3500 1200
Charging fee [10-13]	CF_y	€/kWh	0.35	
Connection rate [13-16]	CR_y	%	42	
Charging usage rate [13-16]	UR_y	%	7	
Electricity price [17]	$C_{Electricity}$	€/kWh	$0.9636 * (MCy * URy * Ny)^{-0.126}$	
Average FCR capacity bid [18]	FCR_{Bid}	€/MW/h	16.6	
Number of EVSE	N_y	Units	Variable	

RESULTS

EBIT

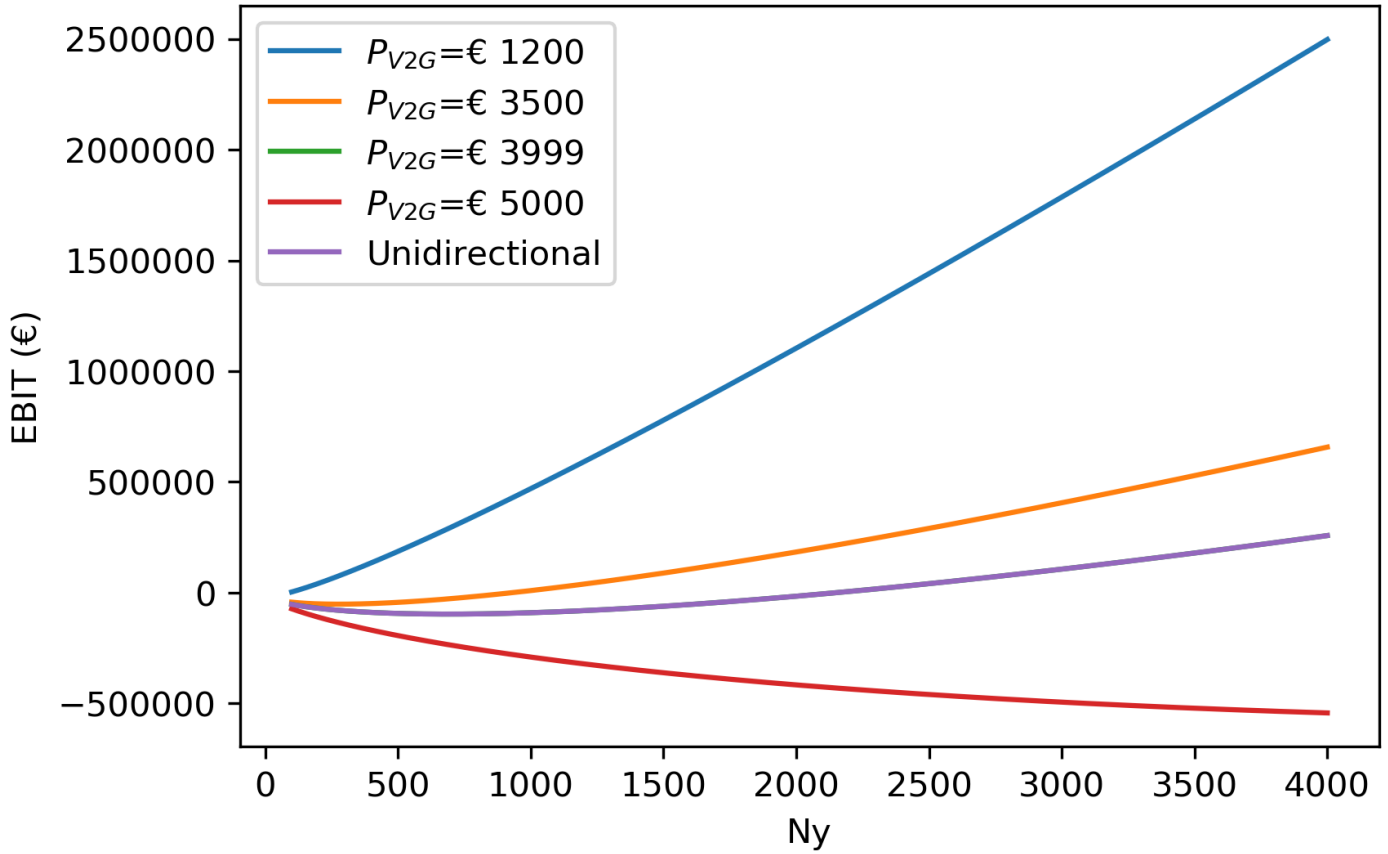


Figure 4: CPO EBIT in function of Ny

RESULTS

EBIT

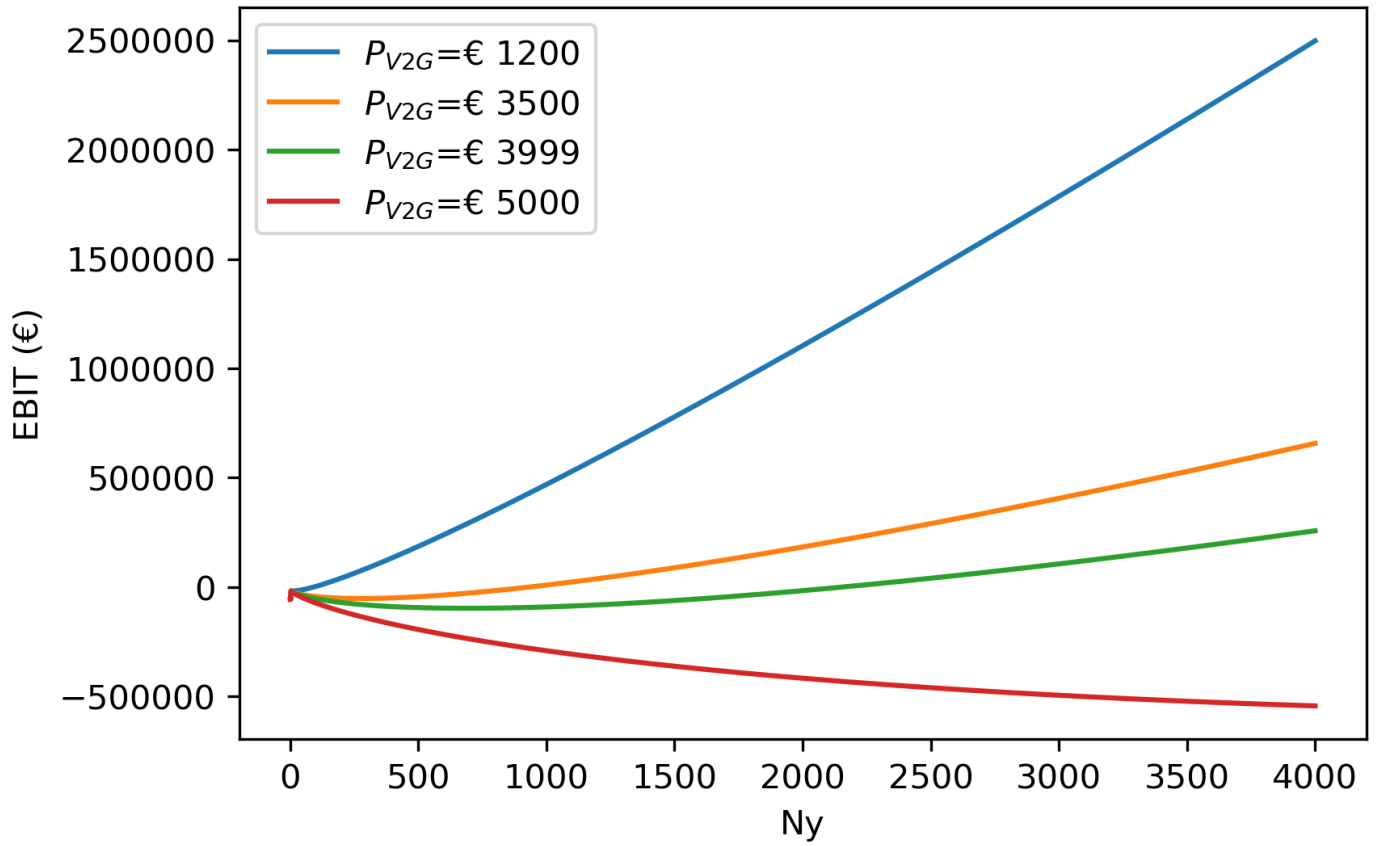


Figure 4: CPO EBIT in function of Ny

RESULTS
EBIT MARGIN

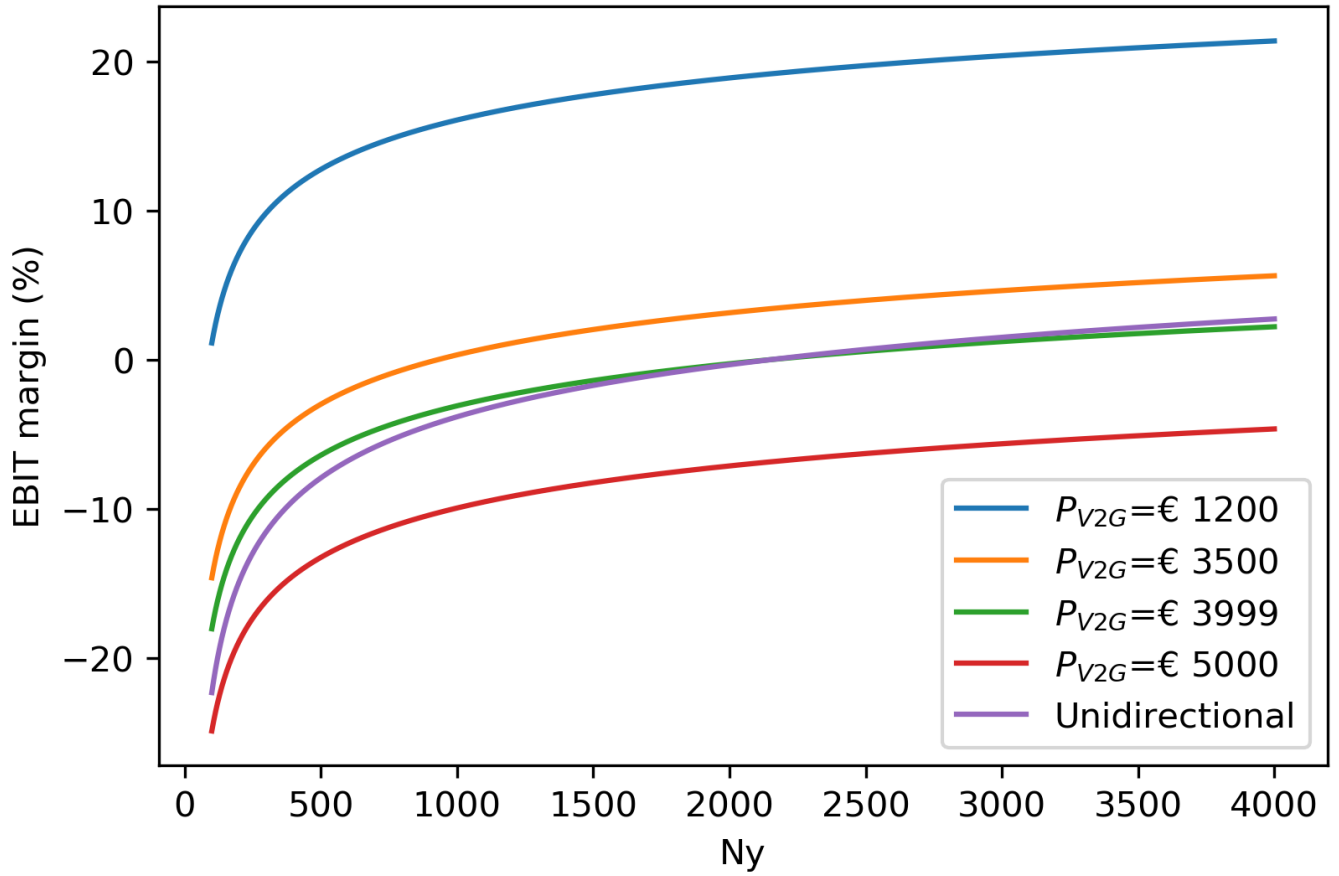


Figure 5: CPO EBIT margin in function of Ny

RESULTS
EBITDA AND EBITDA MARGIN

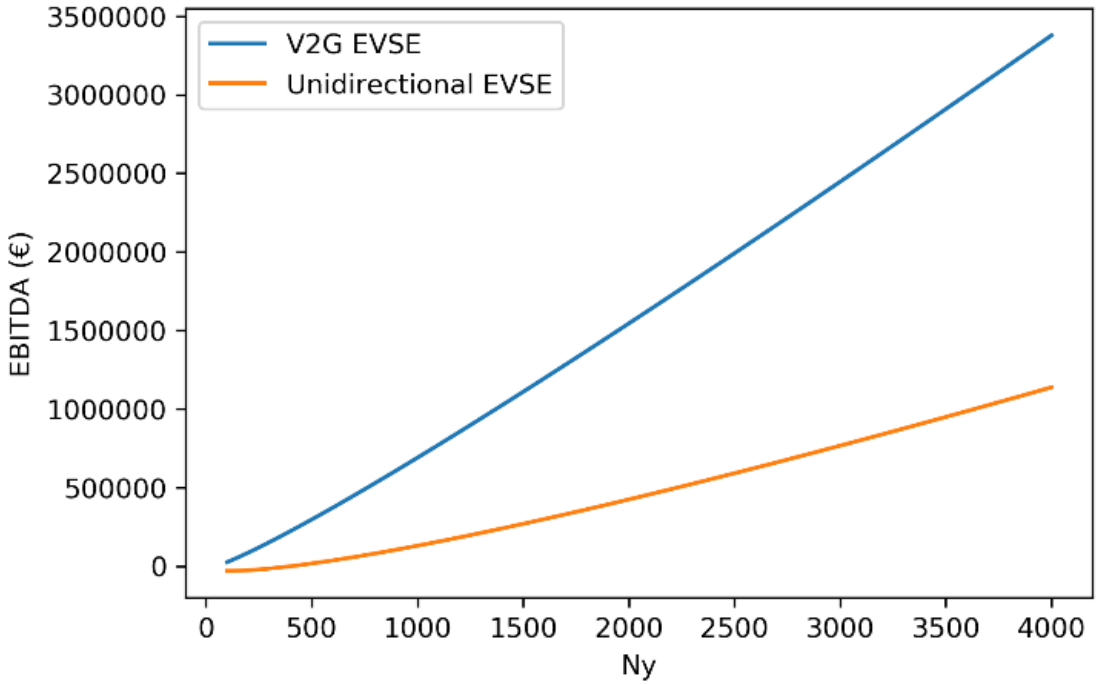


Figure 6: CPO EBITDA in function of Ny

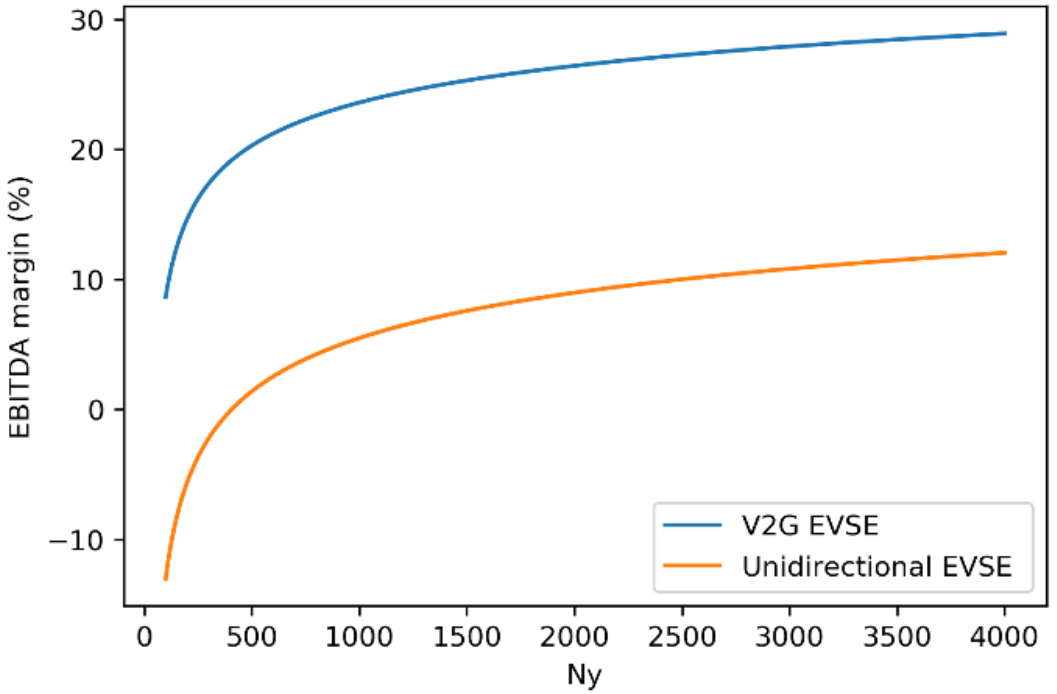


Figure 7: CPO EBITDA margin in function of Ny

RESULTS

ROI

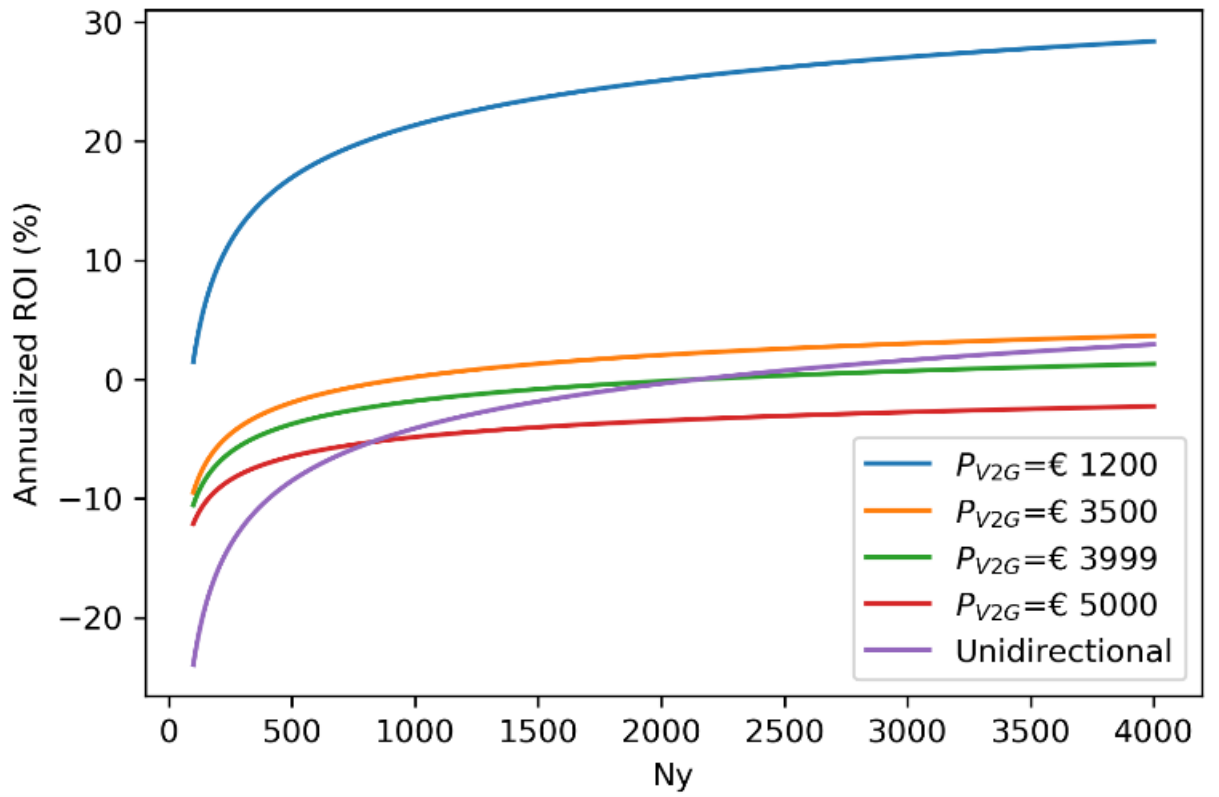


Figure 8: CPO ROI in function of Ny

CONCLUSIONS

- Price of V2G EVSE is an important factor in profitability
  - Current V2G EVSE market price: **€ 5 000**, the traditional business model of a CPO is more profitable than the business model of a CPO after the introduction of V2G-enabled FCR services.
  - Break-even: **€ 3999**, ceteris paribus, equal profitability with the traditional CPO business model
  - Estimated target price: **€ 3500**, higher profitability
- If the V2G EVSE reaches the current level of prices of unidirectional EVSE (**€ 1200**) on the long term, the CPO business model with V2G-enabled FCR services would strongly outperform the traditional CPO business model in terms of profitability.
- V2G-enabled FCR services allow the CPO to reach the profitability faster, but the less capital-intensive unidirectional EVSE can generate a higher ROI on bigger network sizes.

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