The interactions between demand- and supply-side green investment decisions in an oligopolistic market.

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Three key take homes

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Agenda

- Application to electricity market modelling
  - Players in the model
  - Modelling assumptions
  - Research questions
  - Results
  - Limitations

Motivation

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  - No consumer investments
  - All consumers modelled as one

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Electricity market model:

Mixed Complementarity Problem (MCP)

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- Decisions:
  - Investment in solar PV and battery storage
  - Solar PV generation
  - Charging and discharging of battery
  - Load shedding (demand reduction)

Consumer groups

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  - 2 Industrial groups:
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    - **Prosumer** industrial consumers who can invest in solar PV and storage

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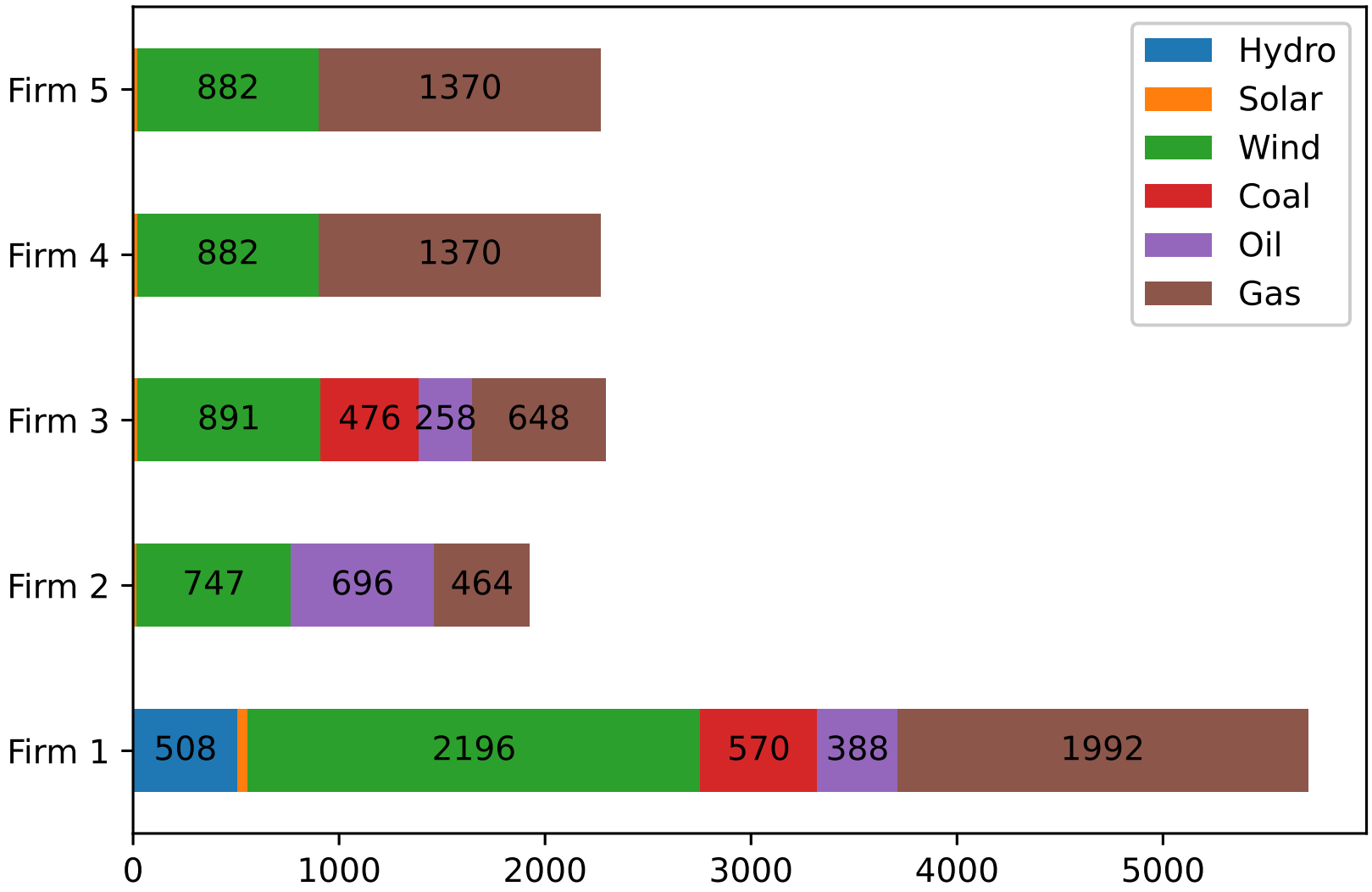
- Decisions:
  - Investment in new generation (conventional, wind, or solar PV)
  - Decommissioning (exit) of existing generation capacity
  - Utilising of their generation portfolio

Data: Initial generating portfolio (MW)



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2. Market Power (MP), *can* influence on price

$$\frac{\partial \pi_t}{\partial gen_j} < 0, \ \ \forall j, t.$$

   - More realistic but more complex (*All* generators **price-makers**)

Myopic behaviour

Price-makers: Firms 1 and 2. Price-takers: Firms 3 and 4

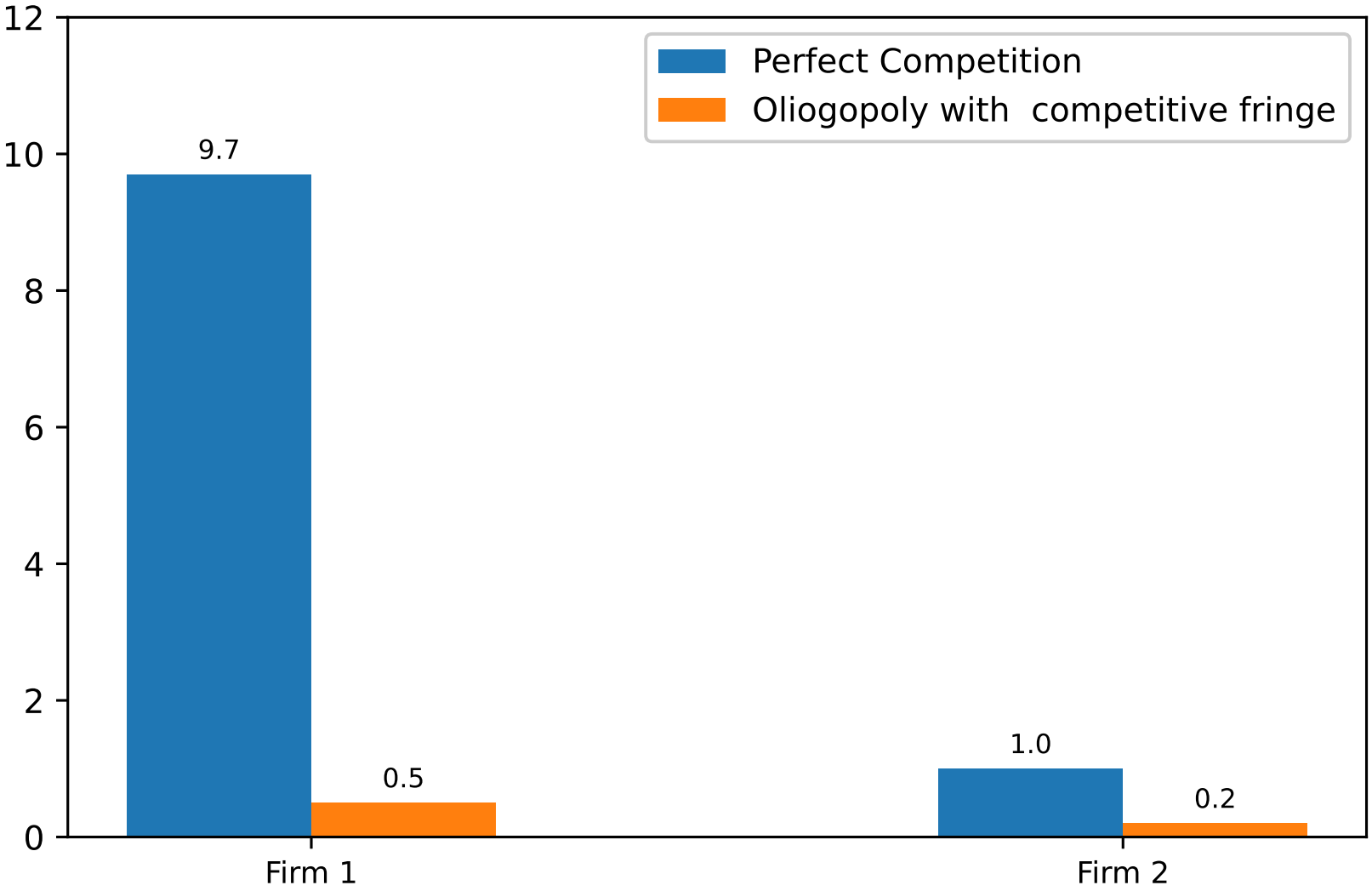

Figure: Profits (€millions)

Myopic investment decisions

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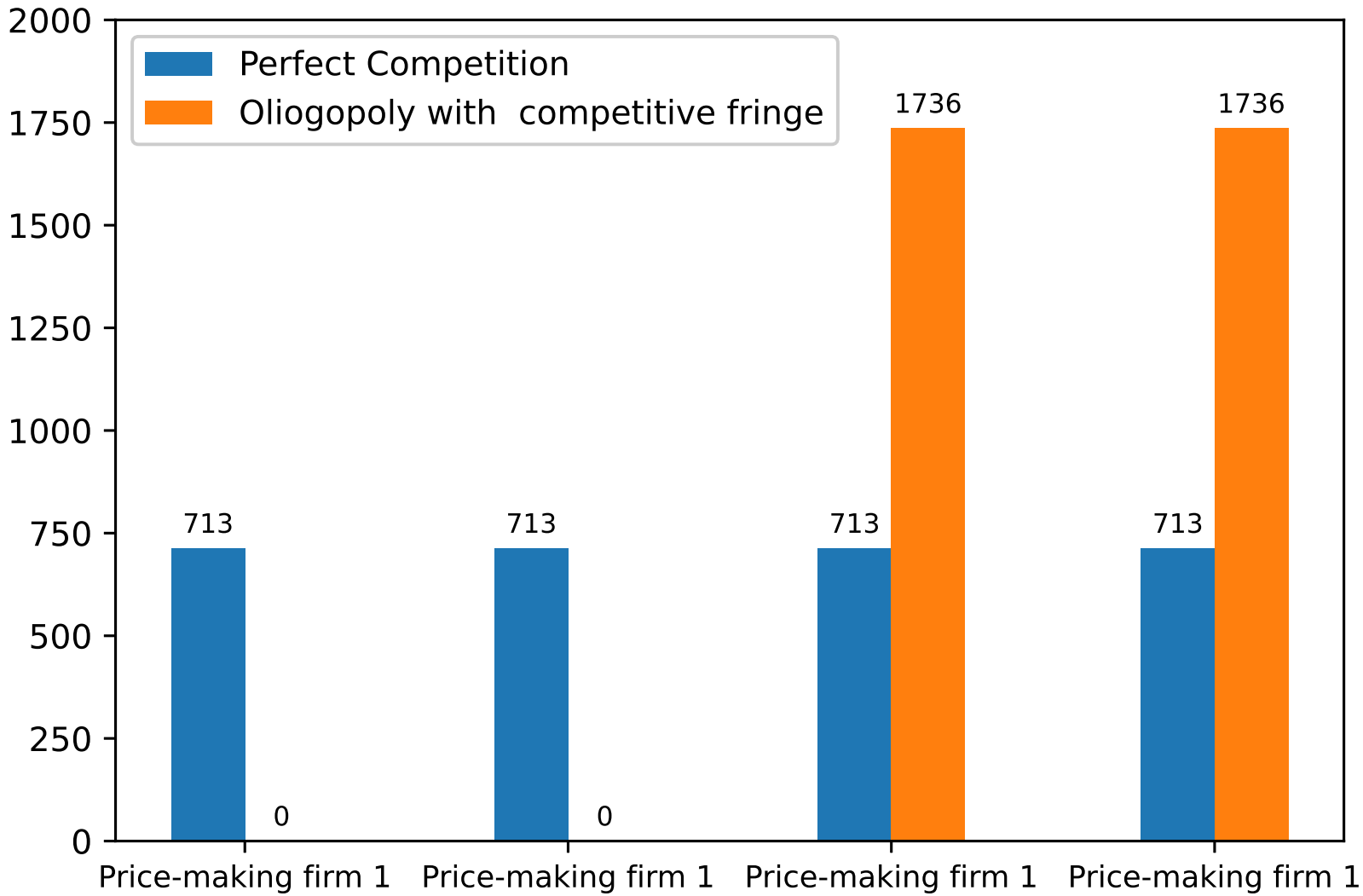

Figure: Investment in CCGT (MW)

Solution to Myopic behaviour

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- EPEC model
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- 6 timesteps

Overall model

- 10 players (10 constrained optimisation problems)
  - 5 Generation firms
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  - Use hierarchical clustering to reduce 35 weather years to 6
- Complementarity Problem solved using a Benders' Decomposition Algorithm

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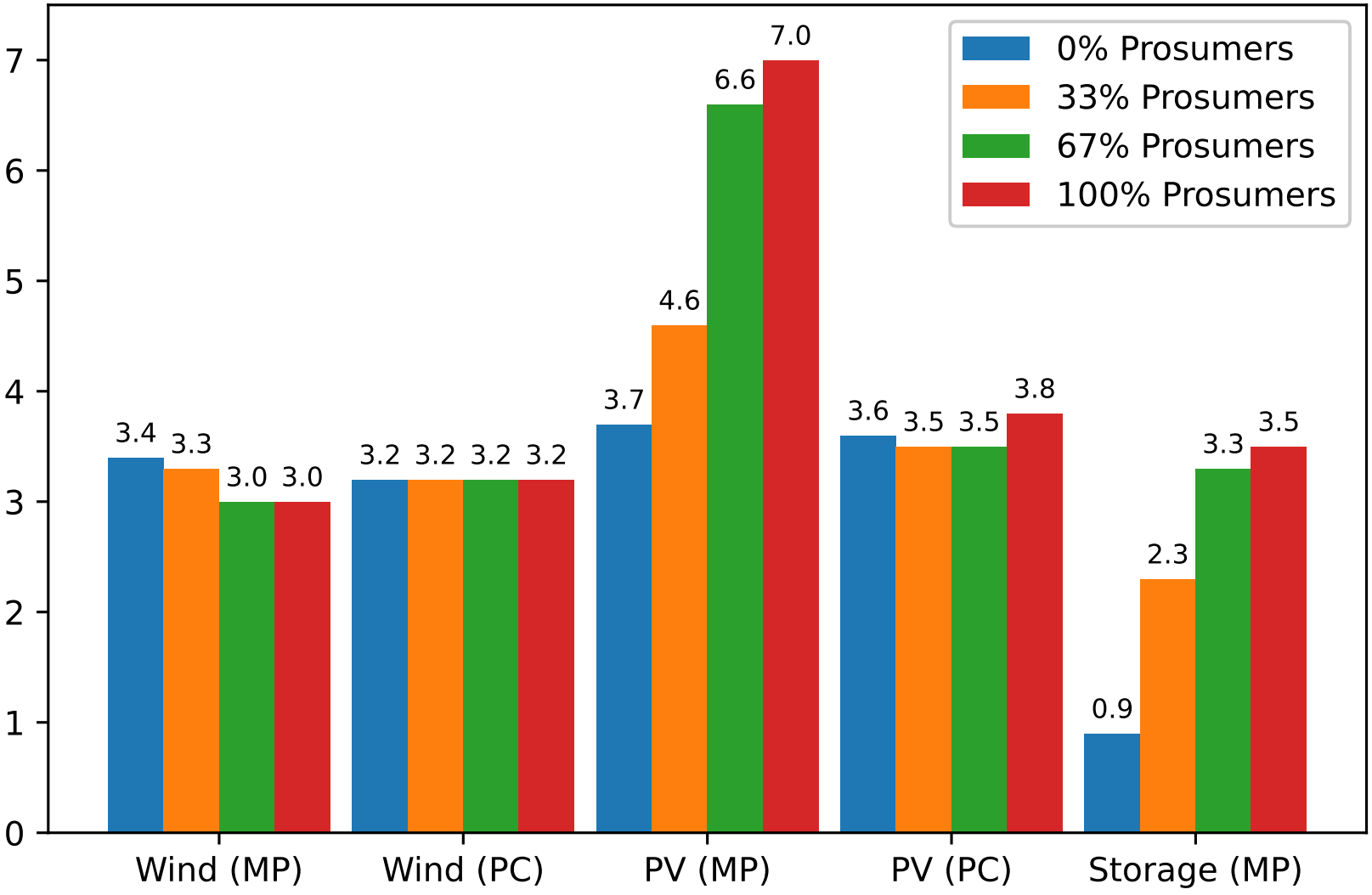
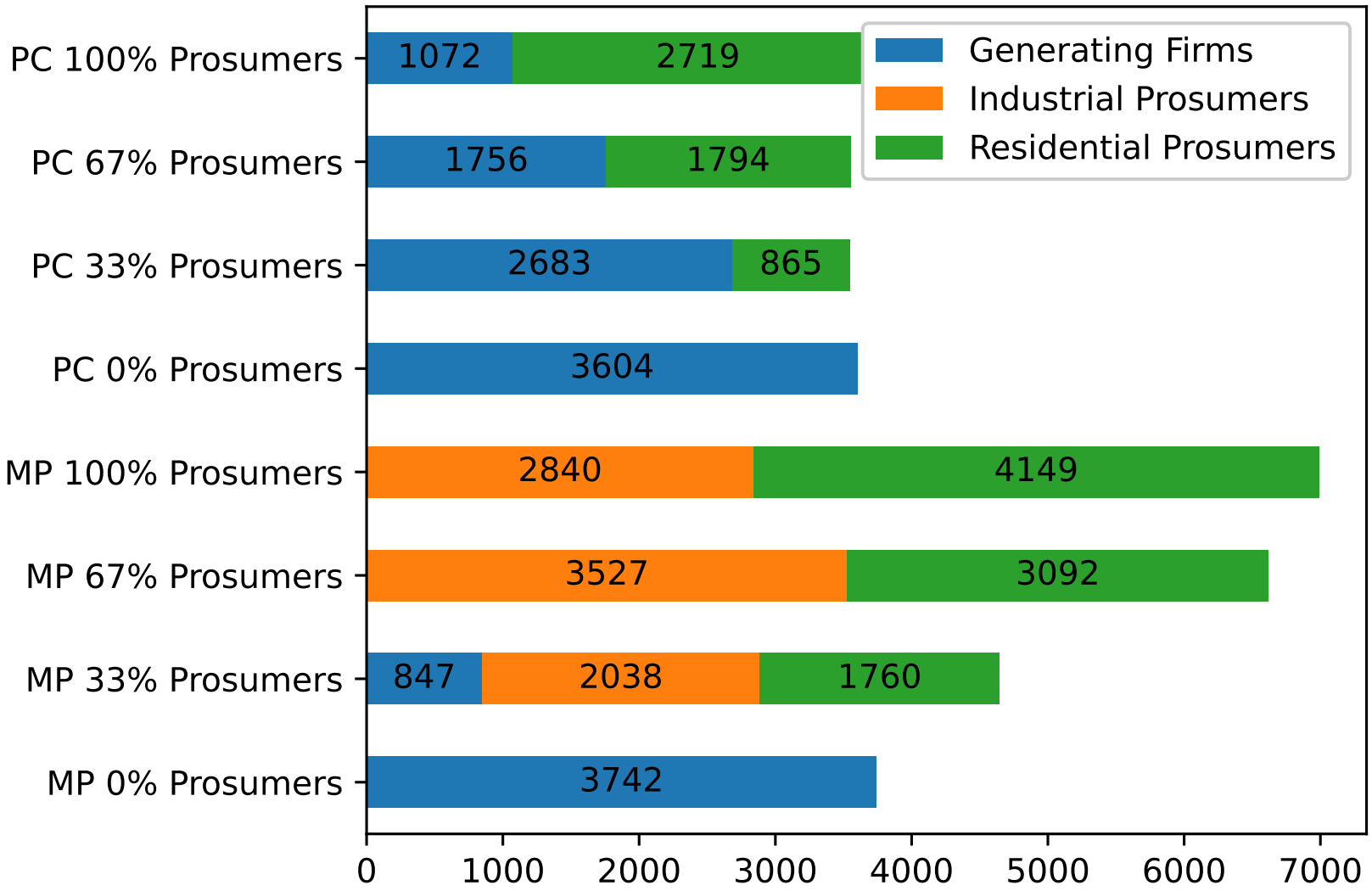
Results

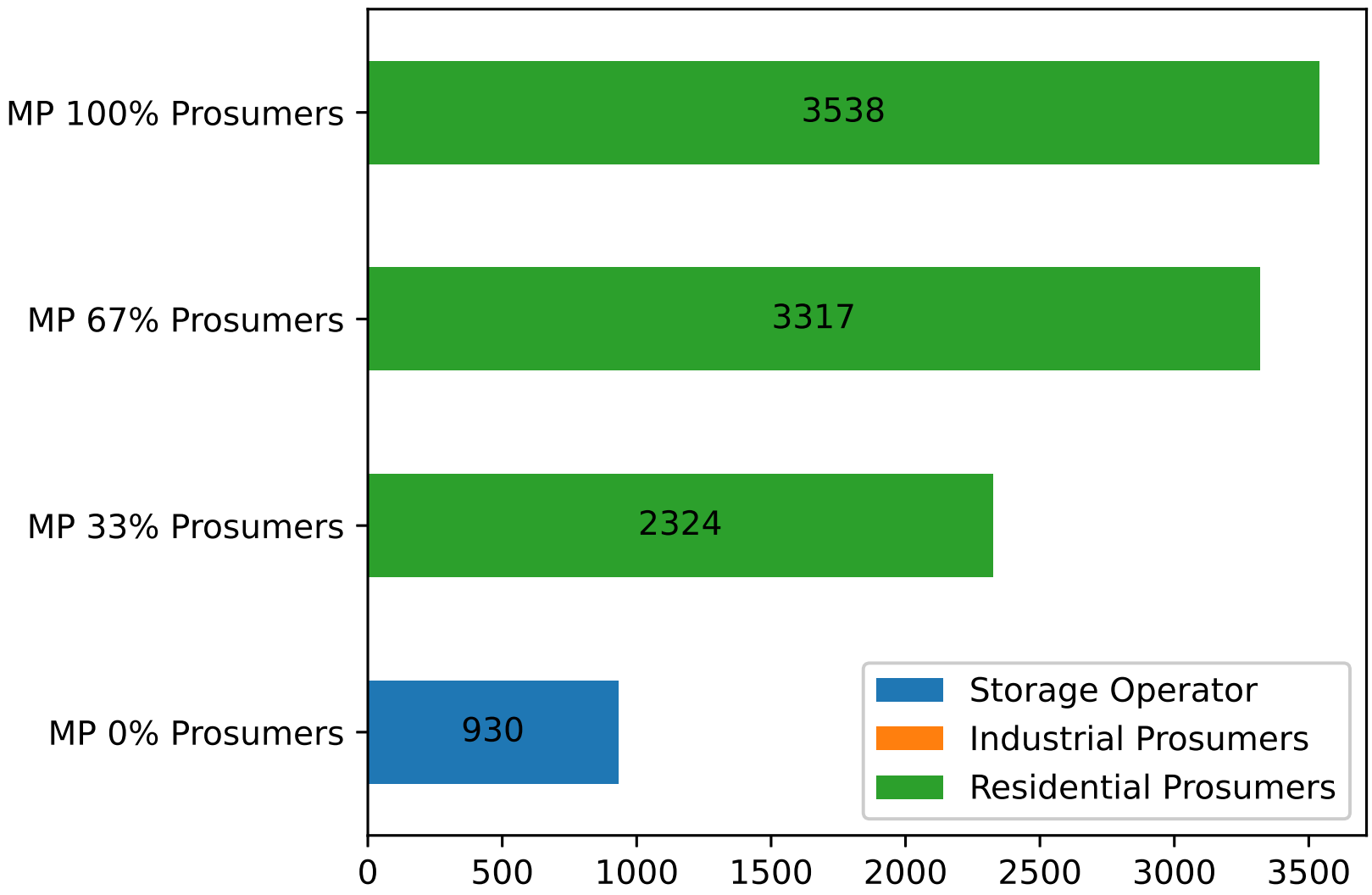
System-wide investments (GW)



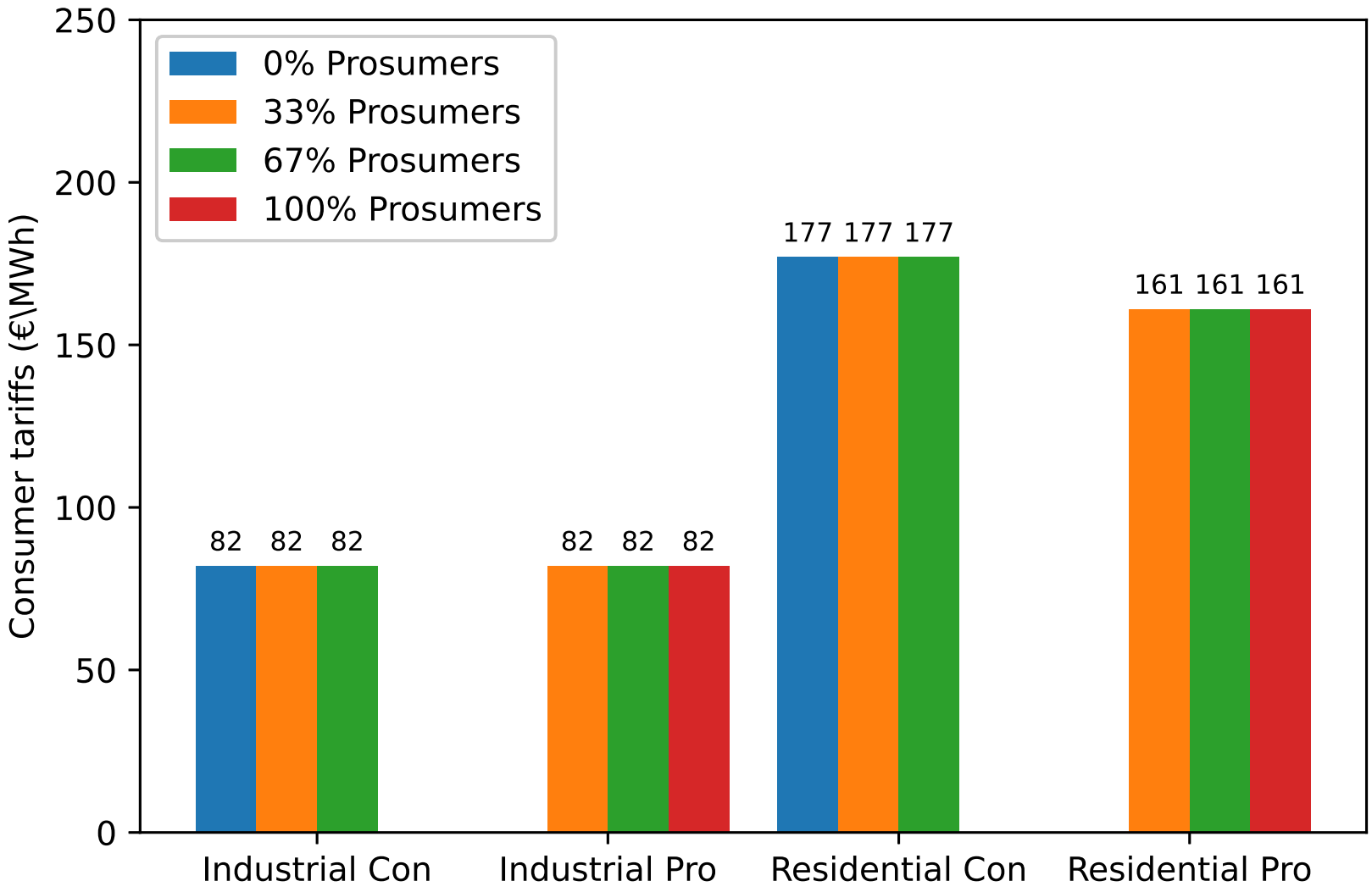
Solar PV investments (MW)



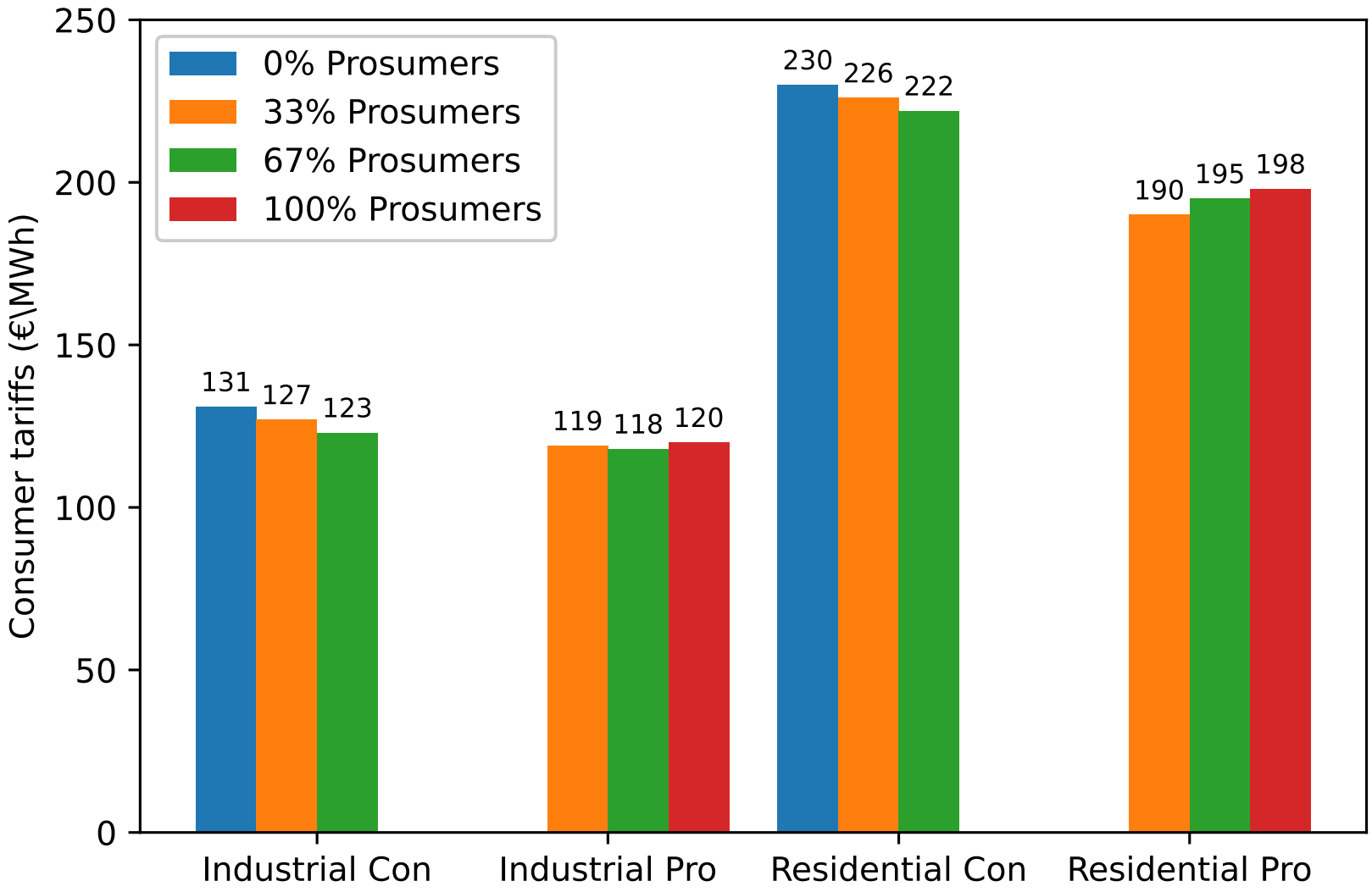
Battery storage investments (MW)



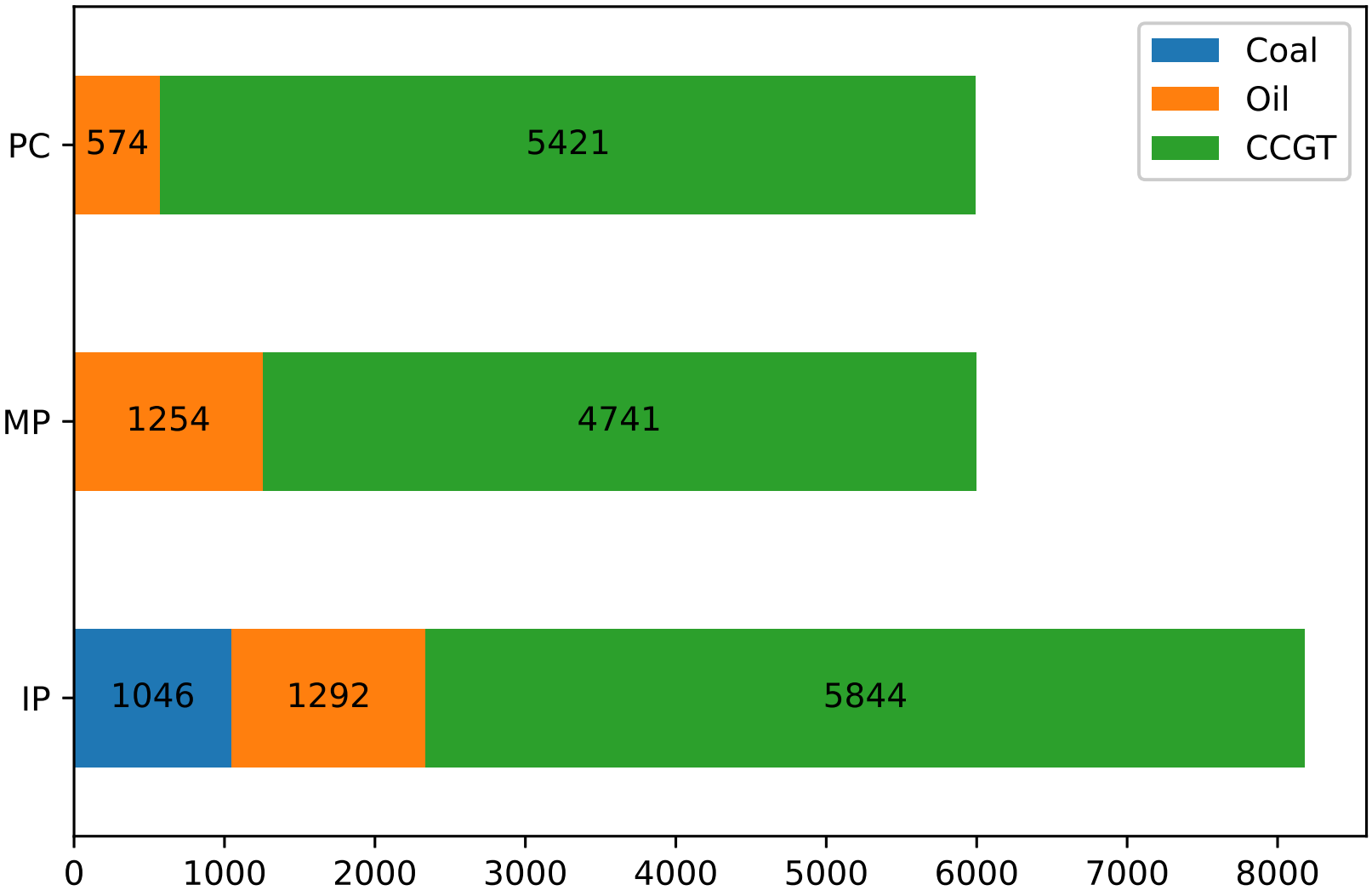
Consumer tariffs under perfect competition (€/MWh)



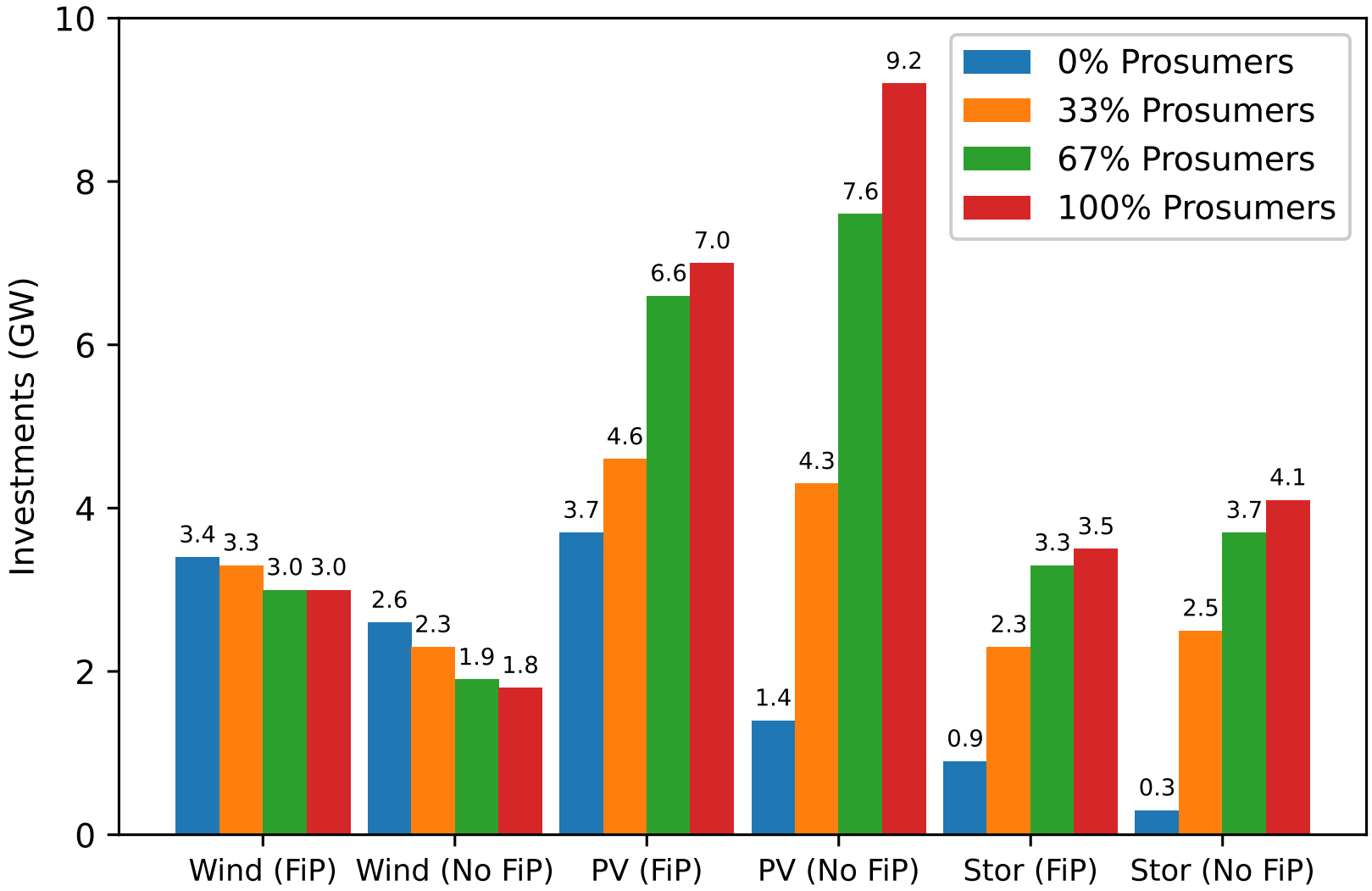
Consumer tariffs under market power (€/MWh)



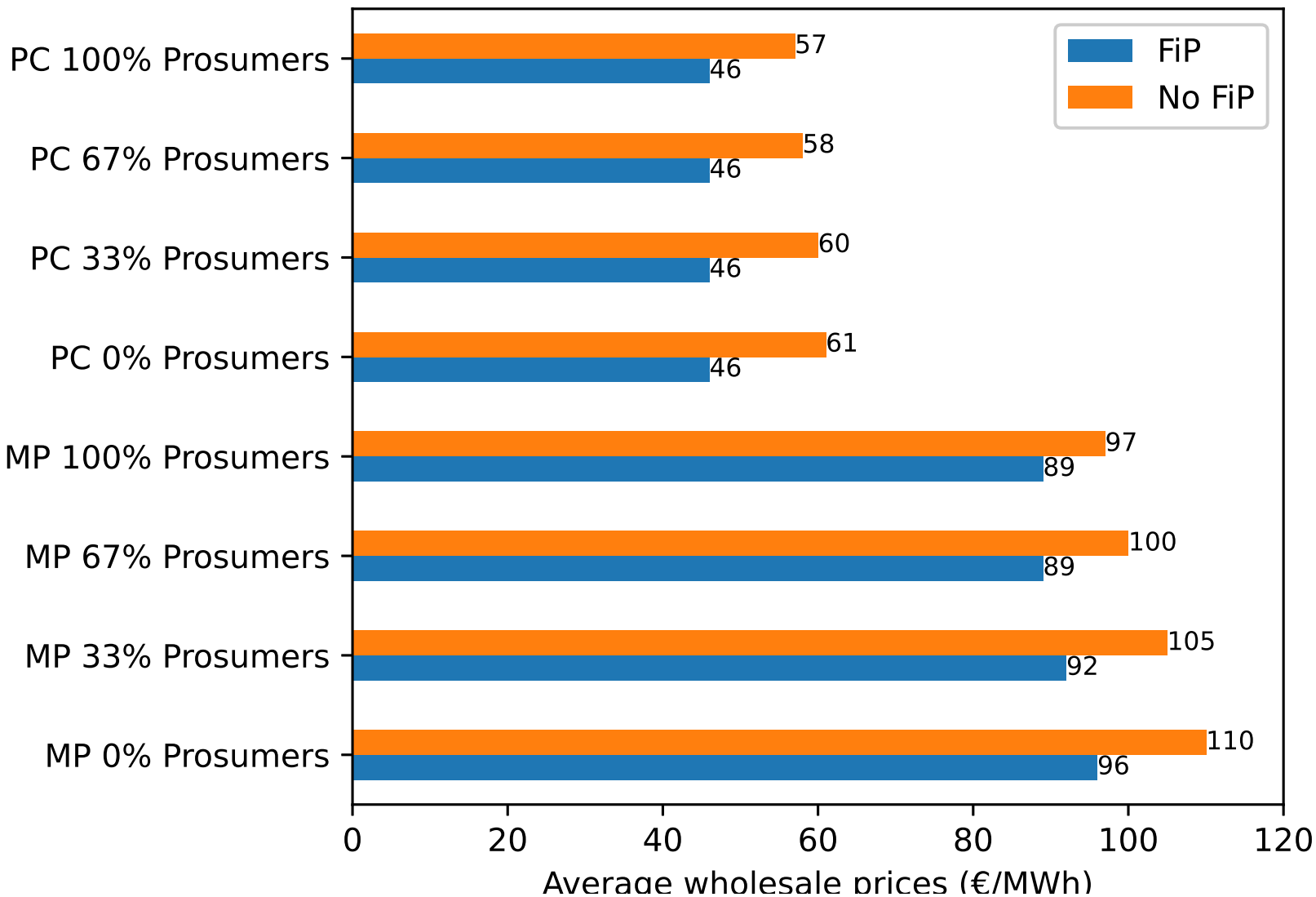
Resulting conventional generation portfolios (MW)



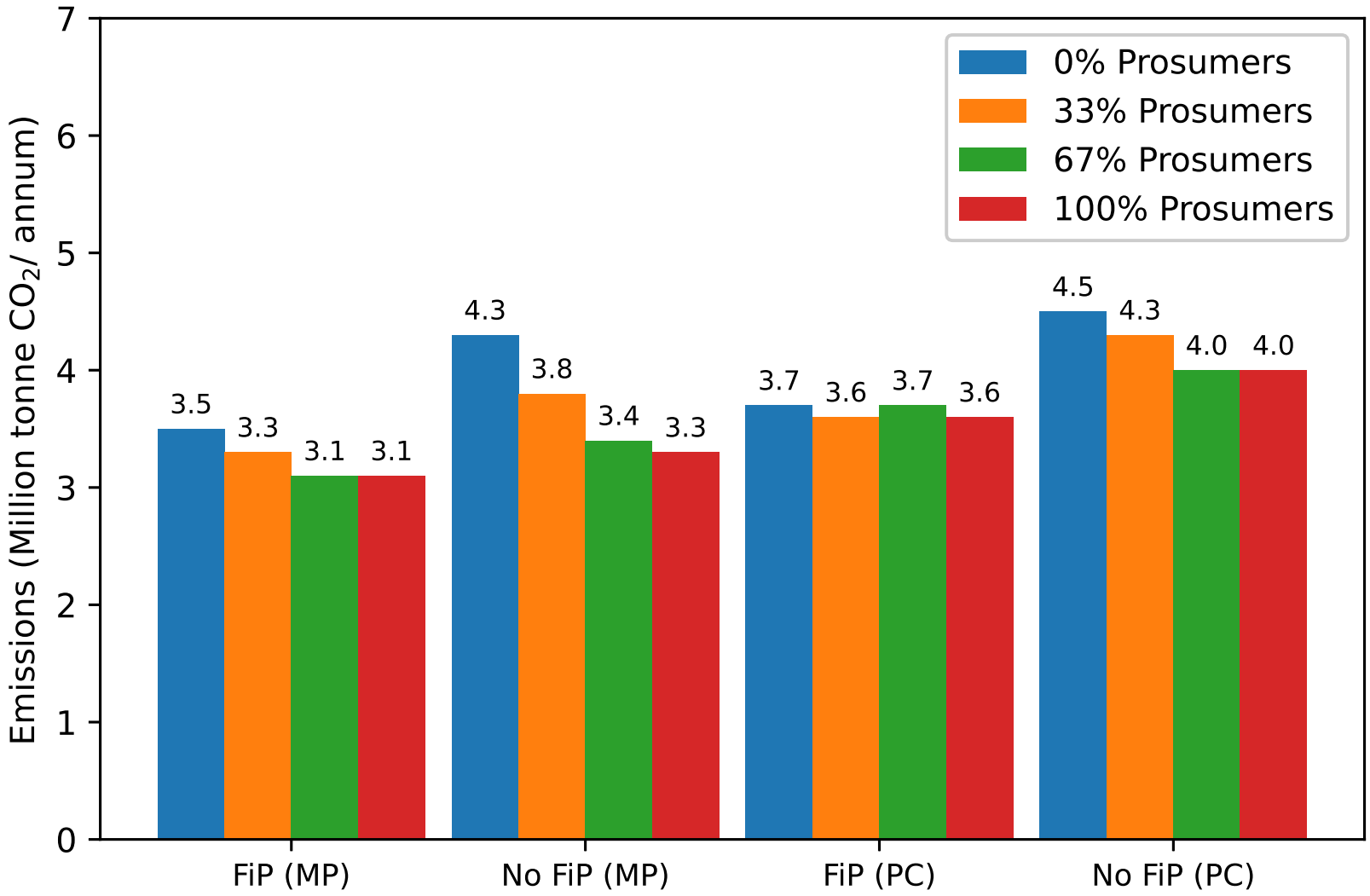
Investments when FiP removed (Market Power) (GW)



Average wholesale prices (€/MWh)



Carbon emissions (Million tonne CO_2/annum)



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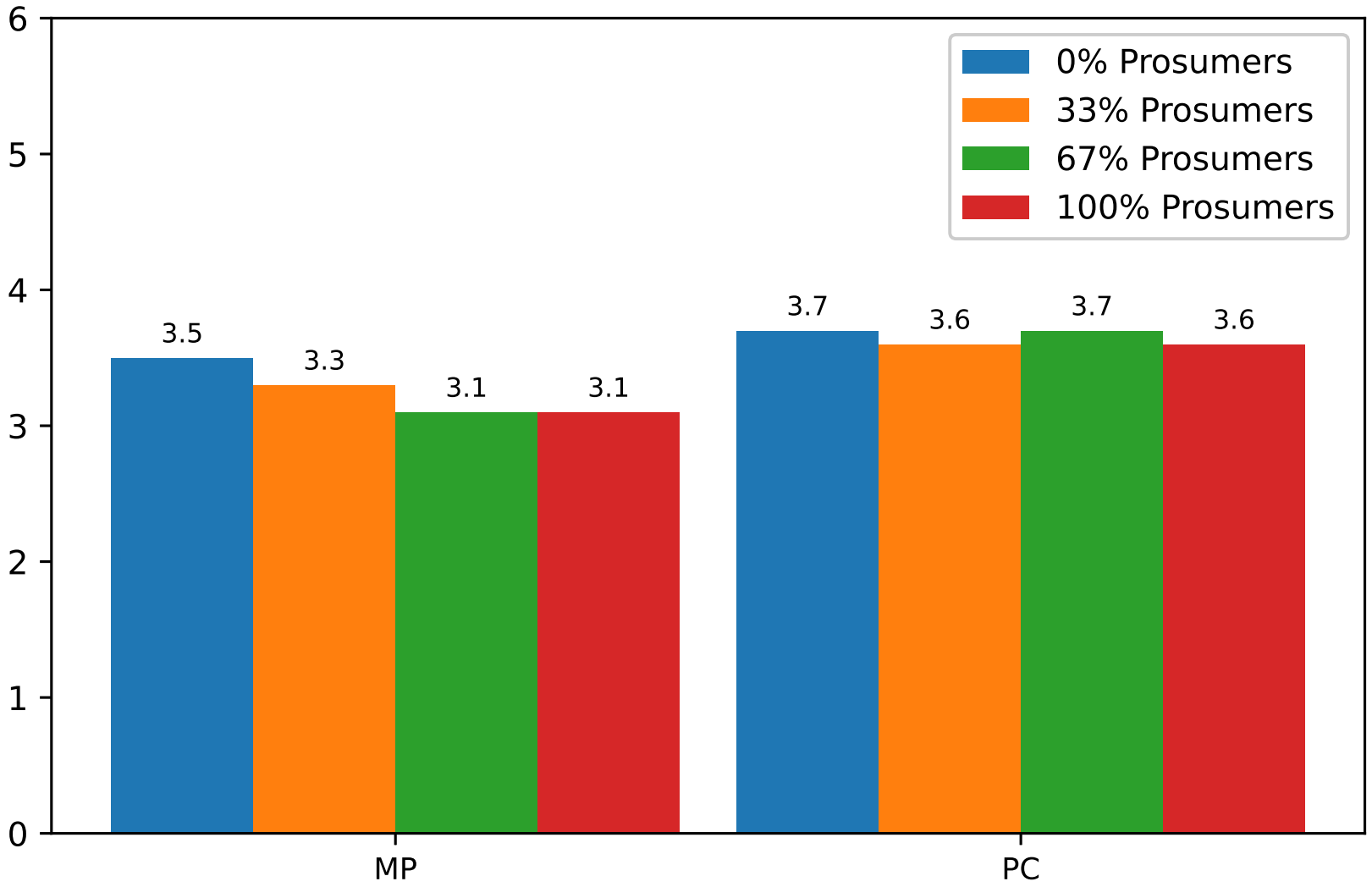

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2. Network Constraints
3. Assumption of 5 Firms

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Questions?

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