



**Energy Turnaround**  
National Research Programme NRP 70



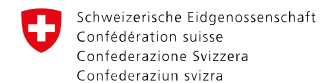
SWISS COMPETENCE CENTER for ENERGY RESEARCH  
SUPPLY of ELECTRICITY

# Market Opportunities and Challenges: Revenue Prospects in a Low Price Market

28.10.2016



In cooperation with the CTI



Swiss Confederation

Commission for Technology and Innovation CTI

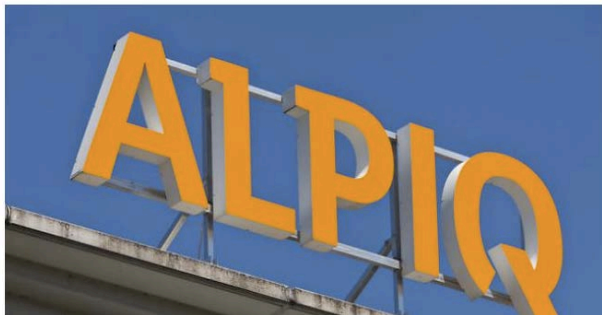
# Challenge

---

**Axpo nach Milliardenabschreiber mit 730 Millionen Franken Verlust**



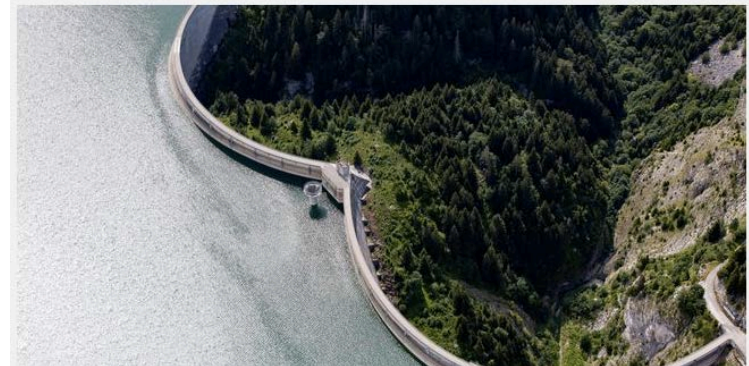
**Alpiq macht nach Abschreiber 902 Millionen Franken Verlust**



## Die Schweizer Grosswasserkraft ist akut bedroht

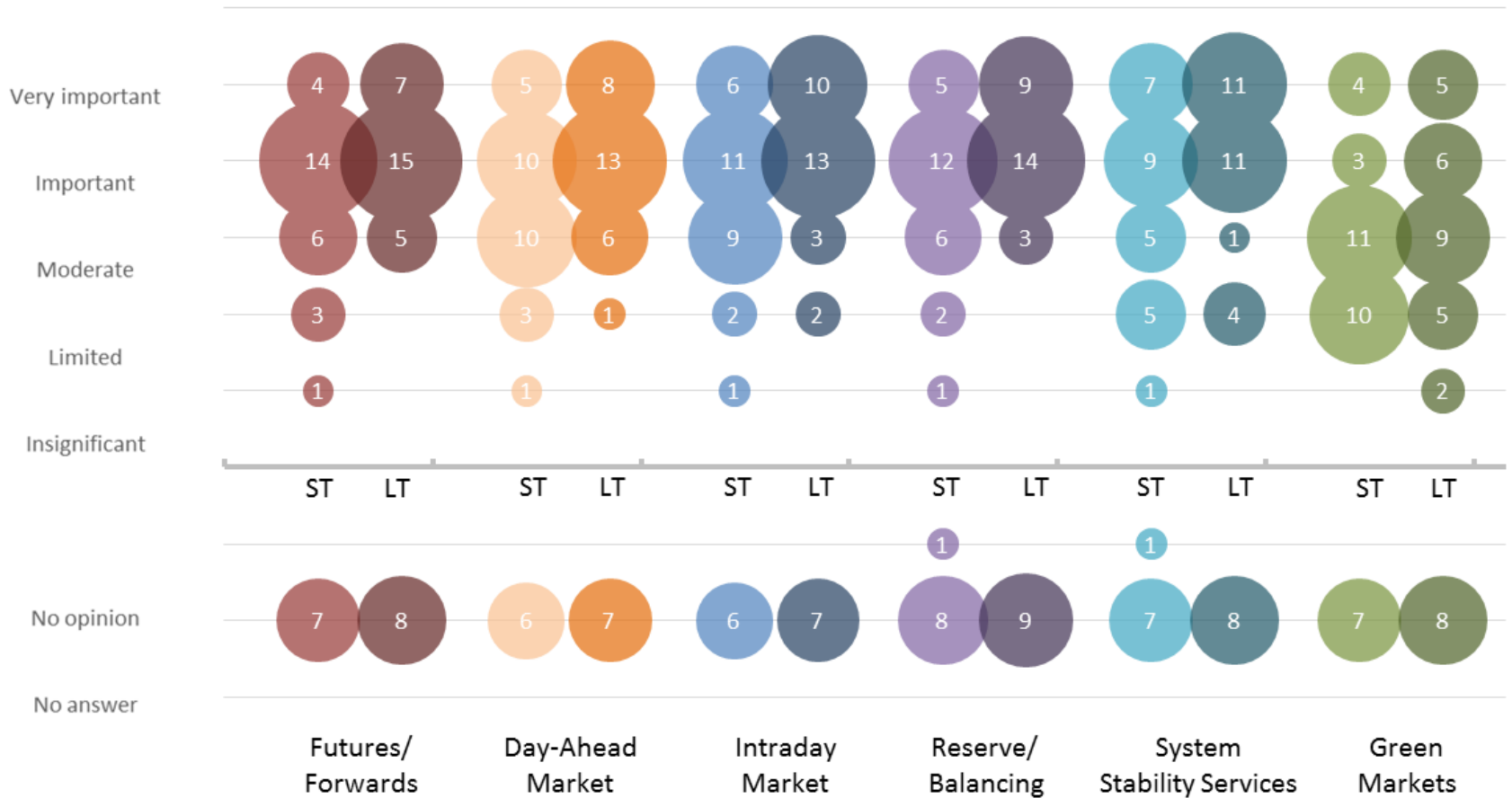
David Thiel, IWB 13.3.2015, 05:30 Uhr

Empfehlen 0 Twittern 5 +1 0



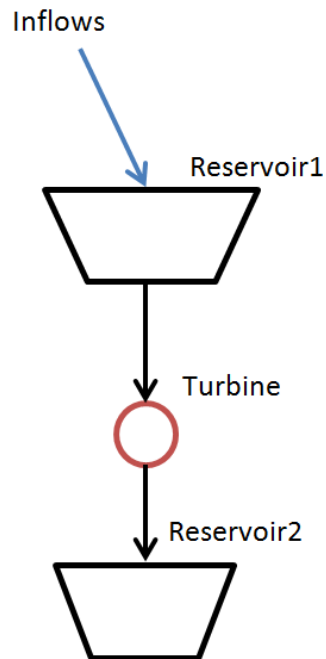
- Falling prices challenge Swiss HP owners
- Discussion about subsidies

# Market Opportunities



# Model

---



## Big:

- 100MW, max 530m head
- Inflow: 1.9x storage, ca. 1000h storage

## Medium:

- 50MW, max 530m head
- Inflow: 40x storage, ca. 72h storage

## Small:

- 22MW, max 350m head
- Inflow: 1300x storage, ca. 3h storage

# Model Limitations

---

## Deterministic:

- Ignoring the impact of uncertainty of prices and inflows

## Average plant characteristics:

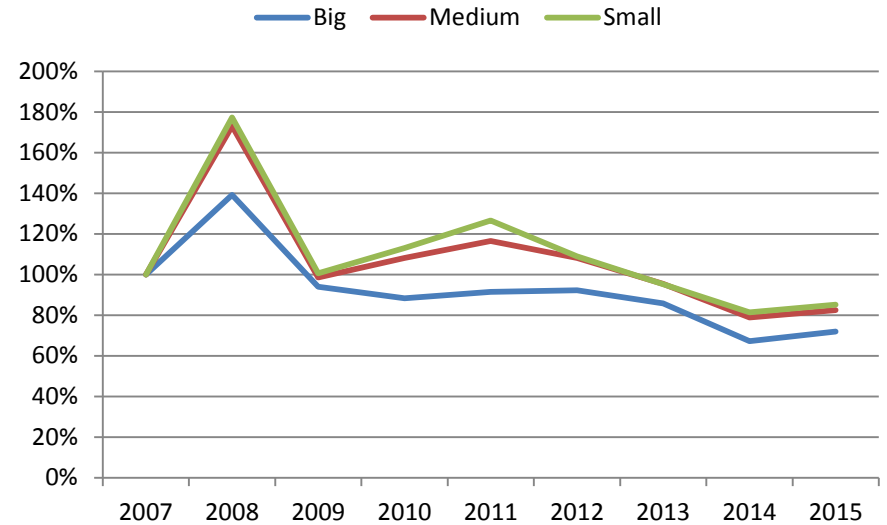
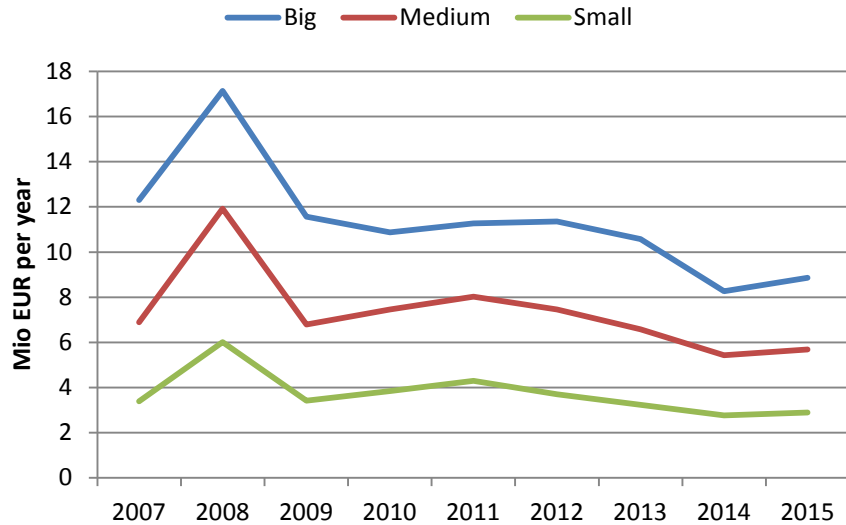
- Inflows are average values
- No specific constraints on residual flows or other regulations

## Single plant perspective:

- No feedback effect of own bidding on market prices
- No optimization of bidding strategy across plant portfolio

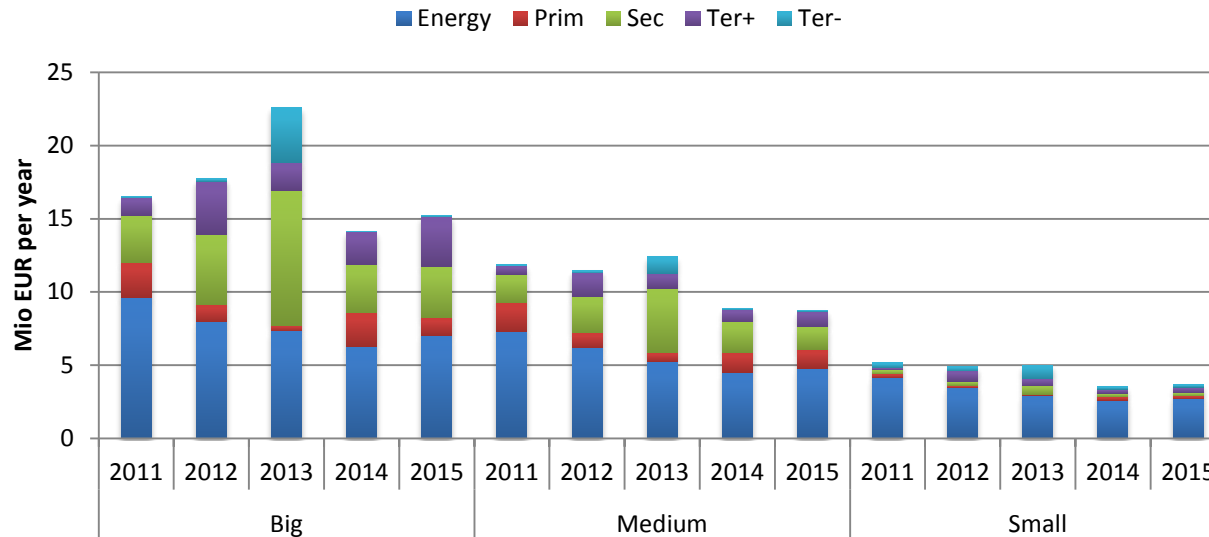
→ Resulting operation represents *theoretical maximum!*

# Falling Prices = Falling Revenue



- Revenue strongly declines (50% of 2008 revenue)
- More decline for large units (depending on the reference year)

# What could have been?



- Significant additional revenue from Balancing markets (20% to 114%)
- Larger storage important (+72/61% for large/medium, +32% for small)

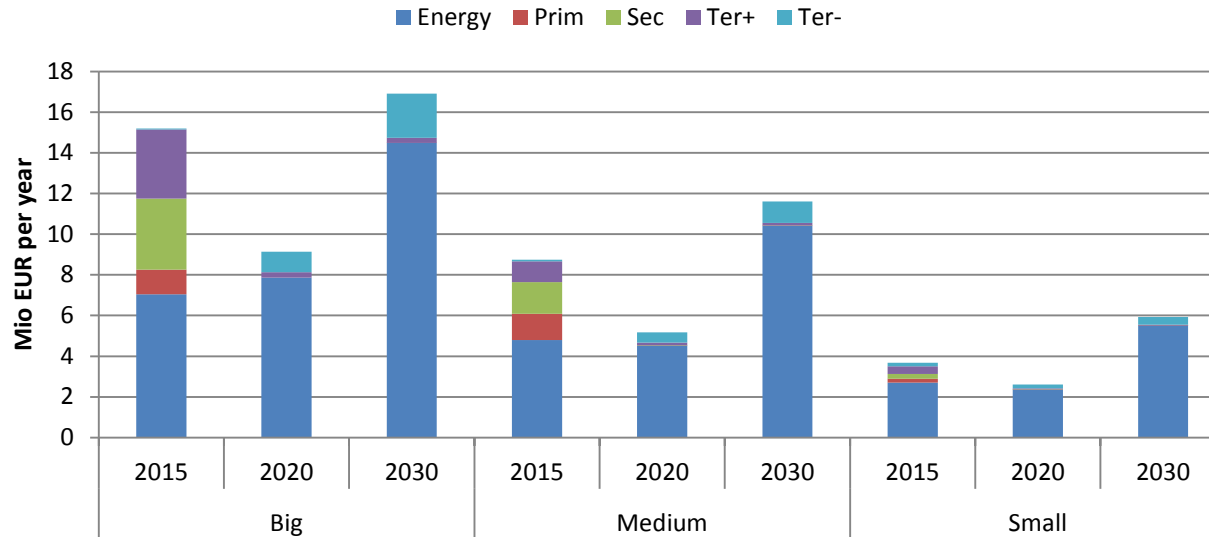
# Scenario Overview

---

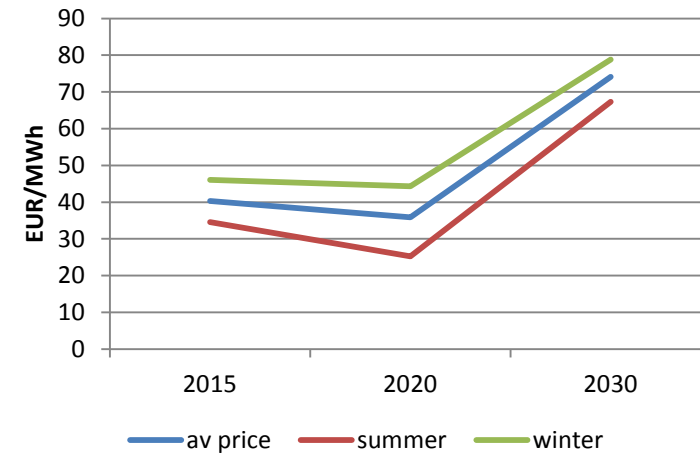
- **EU Reference Scenario:** as is EU Energy Trends
- **Base EU Trend Scenario:** based on EU Trends, own investment
- **Base Price 2015 Scenario:** what if prices prevail
- **Base Fuel High Scenario:** 50-100% fuel price increase by 2030
- **Base Carbon High Scenario:** carbon price increase to 34€/t CO<sub>2</sub> in 2030
- **Base RES x 10 Scenario:** 10% more RES
- **Base RES x 20 Scenario :** 20% more RES



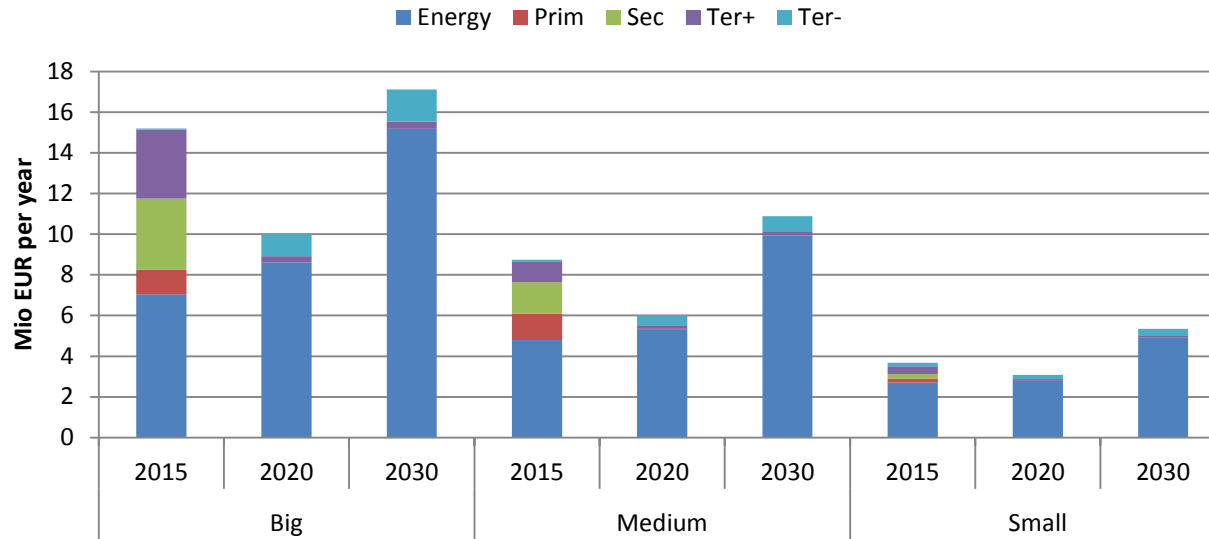
# EU Reference Scenario



- Revenues first decreasing but increasing till 2030 again
- 8-15% higher revenues due to balancing
- Highest balancing revenues form negative TRL

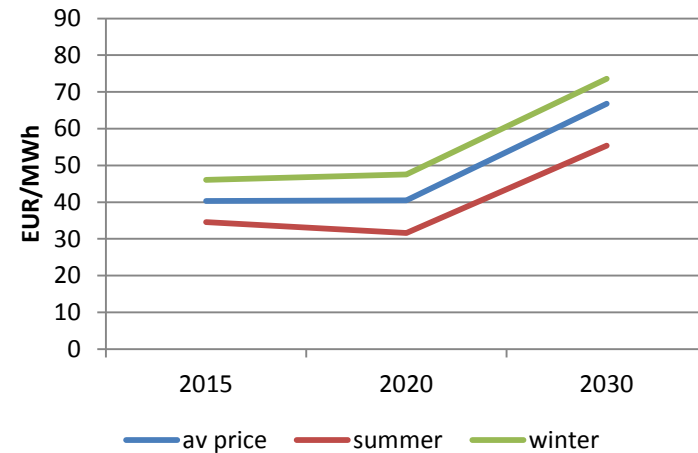


# Base EU Trend Scenario

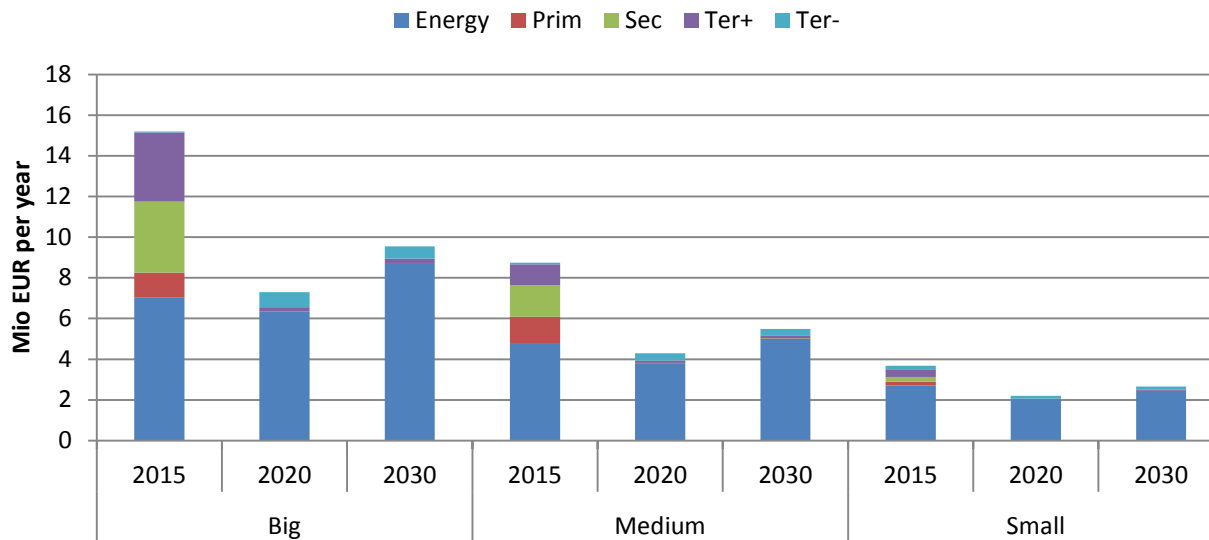


Same fuel prices but different investment leads to altered effects:

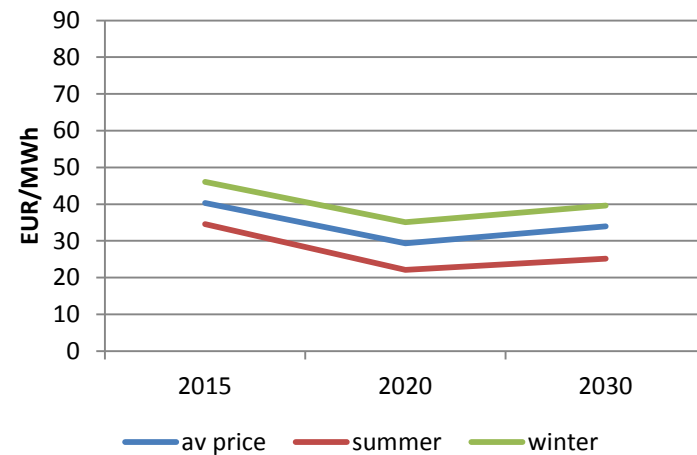
- Balancing even less important
- Big units benefit
- Medium/Small loose



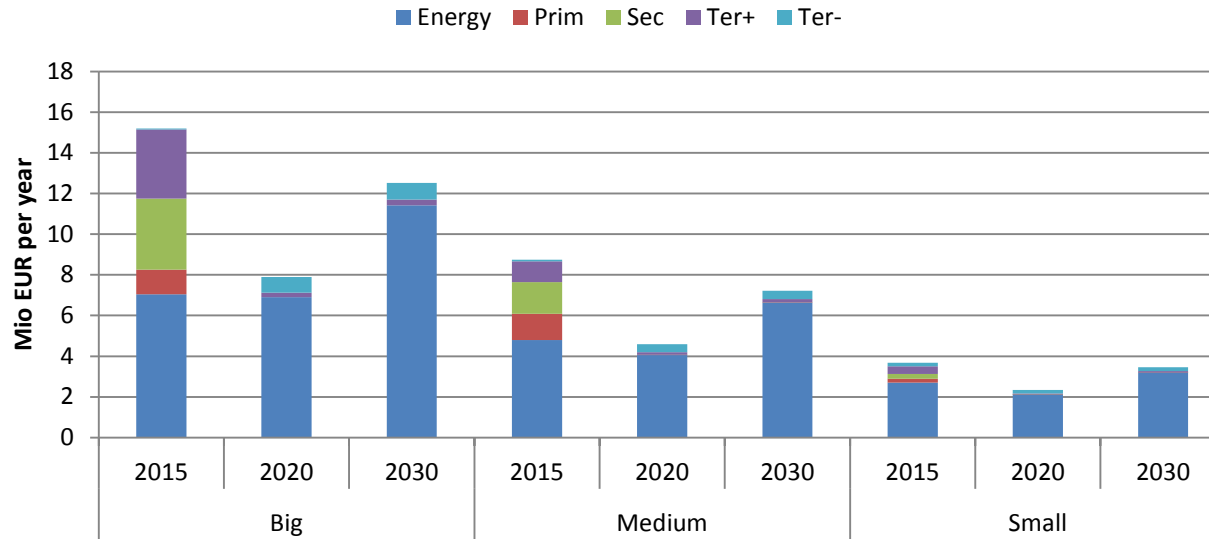
# Base Price 2015 Scenario



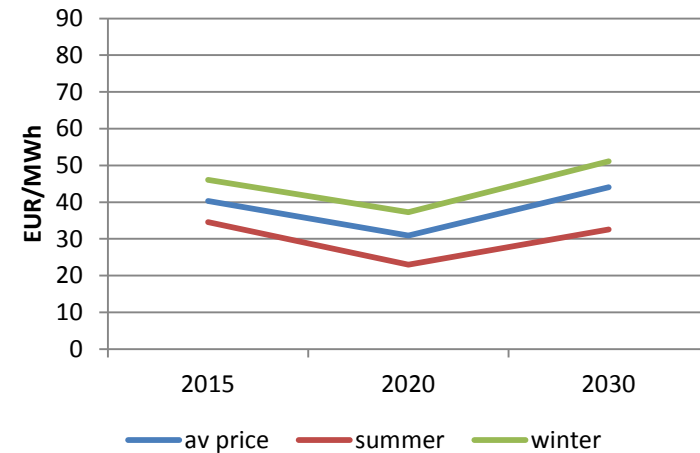
- Continuous low fuel prices and EU overcapacity are a long term threat
- Rush to balancing markets would reduce current potential



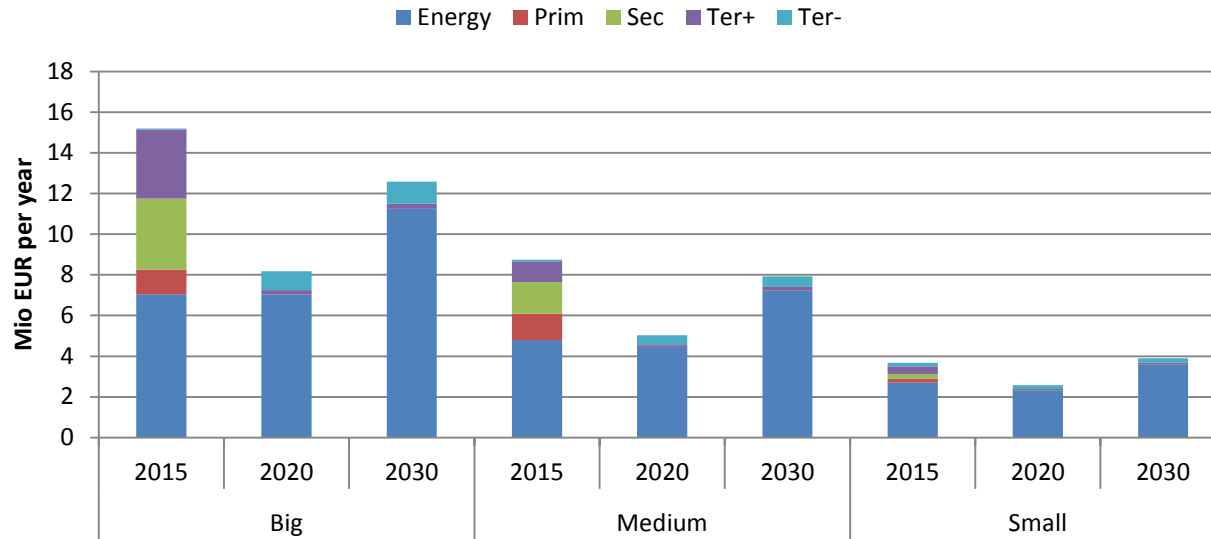
# Base Fuel High Scenario



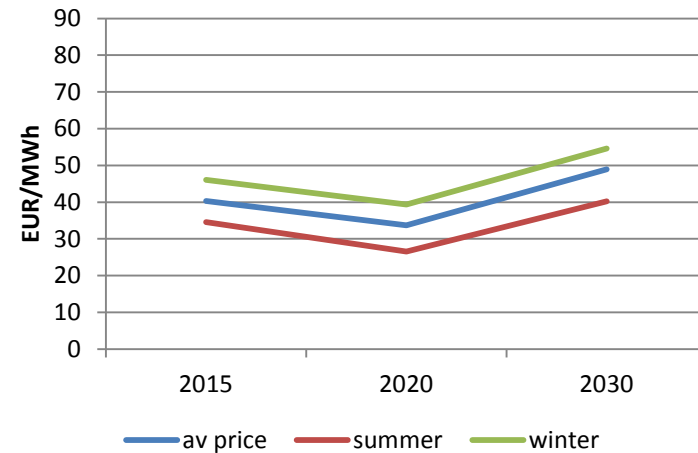
- A slow recovery of fuel prices will relax the situation
- Big Question: how long will it take?



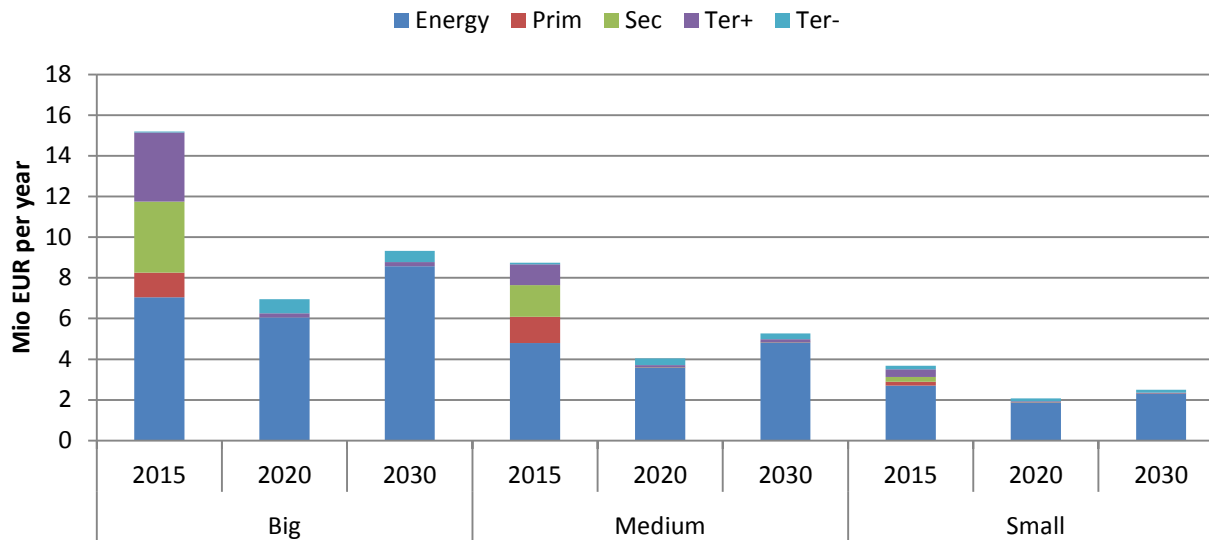
# Base Carbon High Scenario



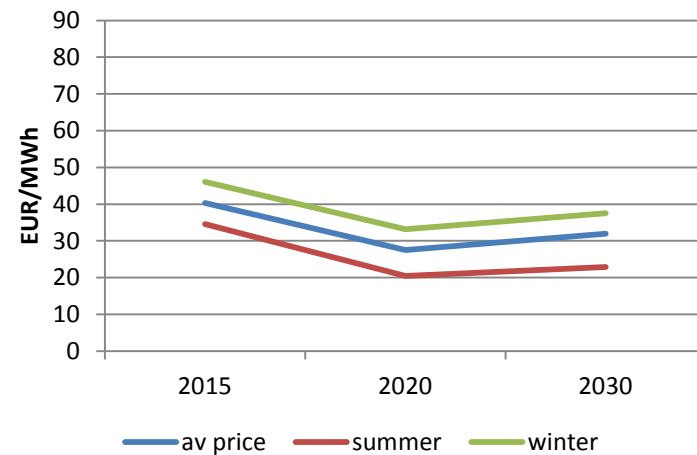
- Higher carbon prices are less important for large units (peak price driven)



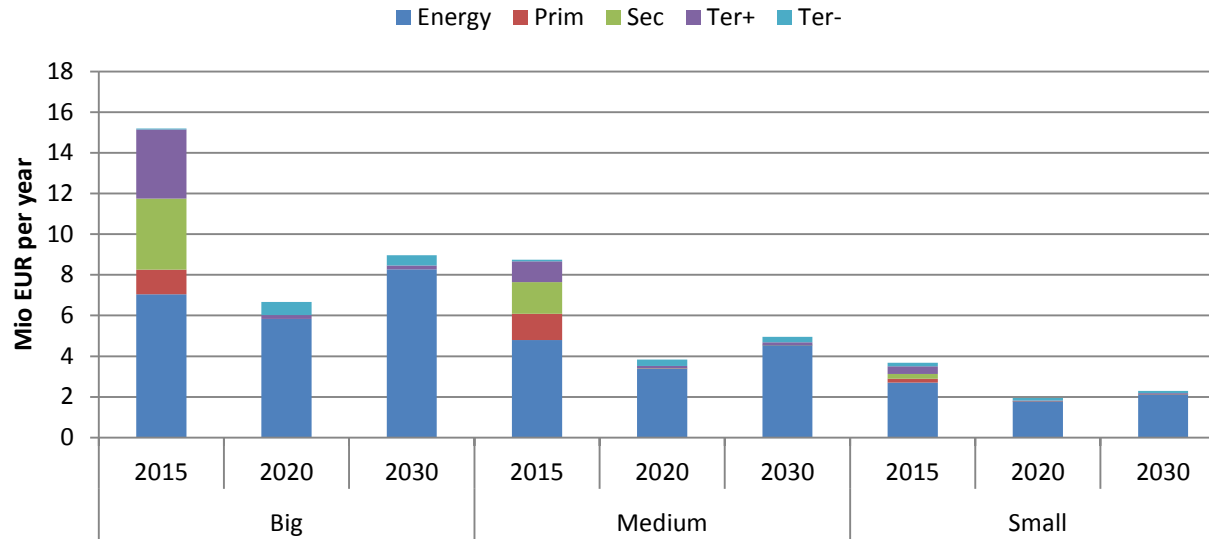
# Base RES x 10 Scenario



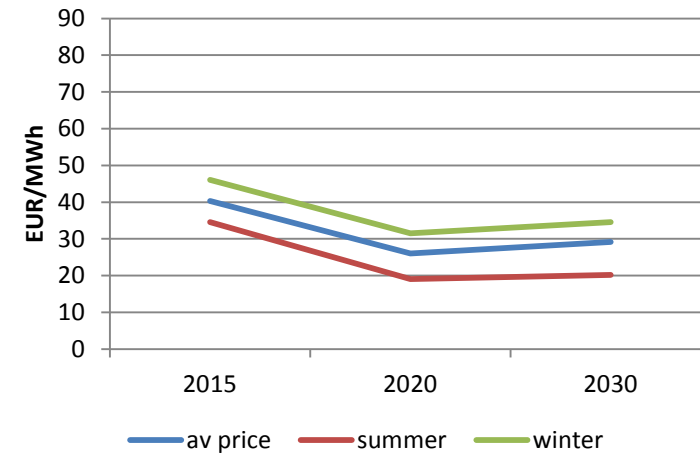
- Higher RES share further decrease prices and revenues
- Balancing prices not increased due to higher RES share as no increase in balancing requirement assumed



# Base RES x 20 Scenario



- A faster increase of RES coupled with low fuel prices will lock-in prices below 30€/MWh



# Conclusion

---

- Market price prospects for coming decade low to modest, existing EU capacity structure likely to remain stable
- Global fuel markets and ETS as decision makers for Swiss HP**
- Balancing market benefits significantly reduced if full Swiss HP aims for Balancing, more important for larger units
- Optimized operation helps, but is limited in scale**

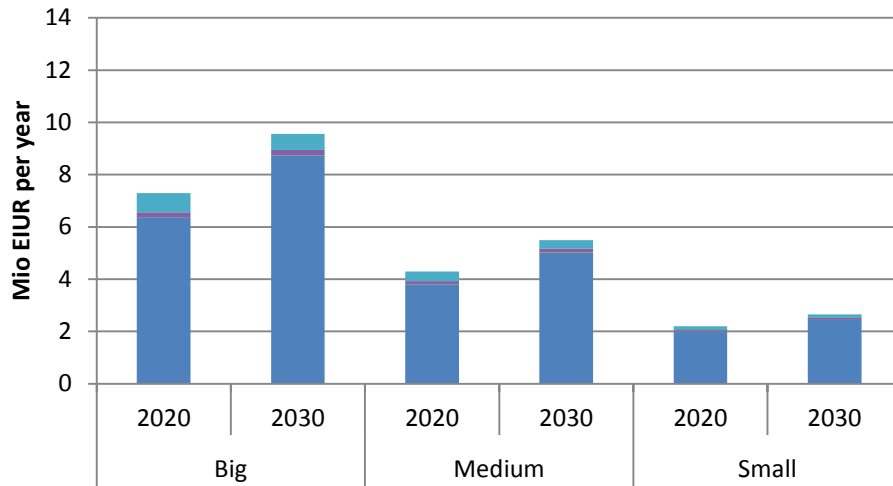


# Technology Options

- Base Price 2015 Scenario:

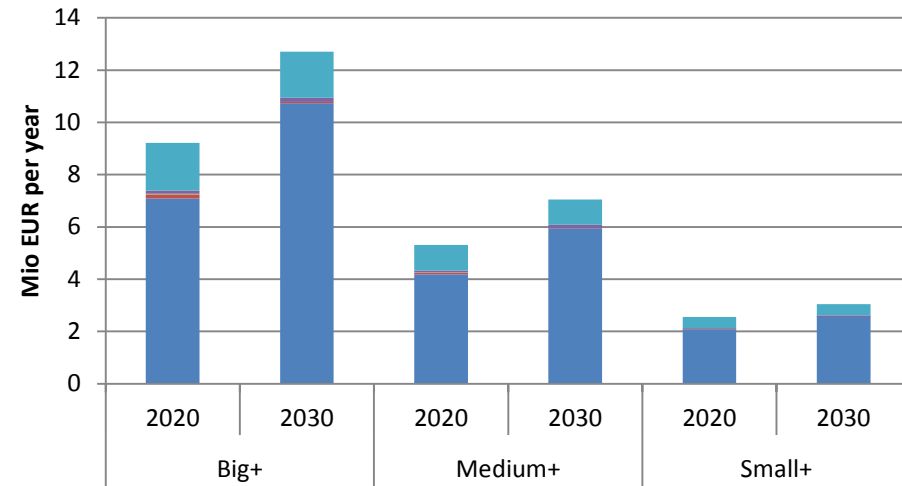
## without pump

■ Energy ■ Prim ■ Sec ■ Ter+ ■ Ter-



## with pump

■ Energy ■ Prim ■ Sec ■ Ter+ ■ Ter-



# Discussion

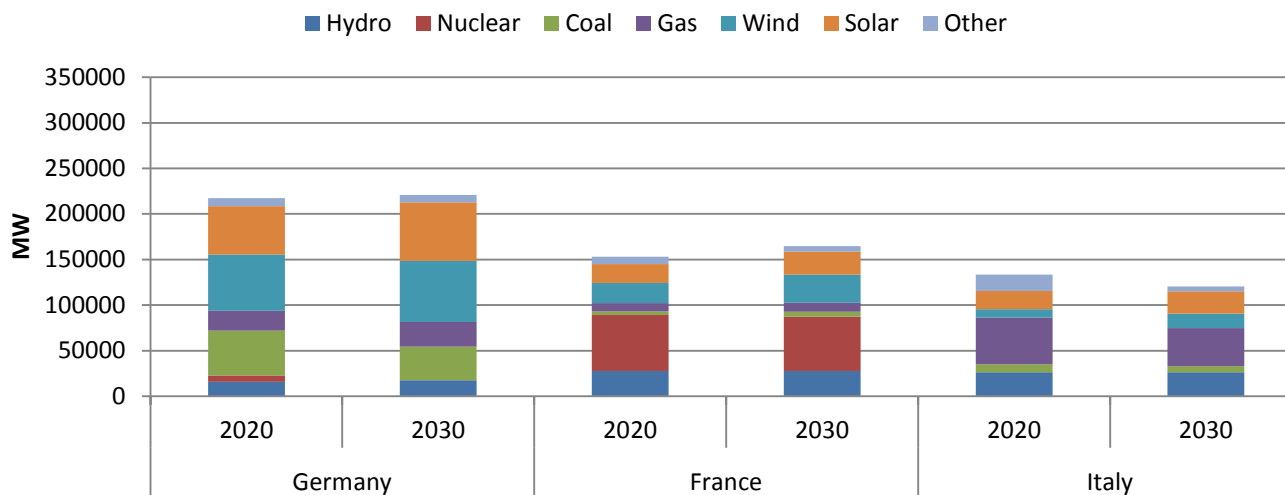
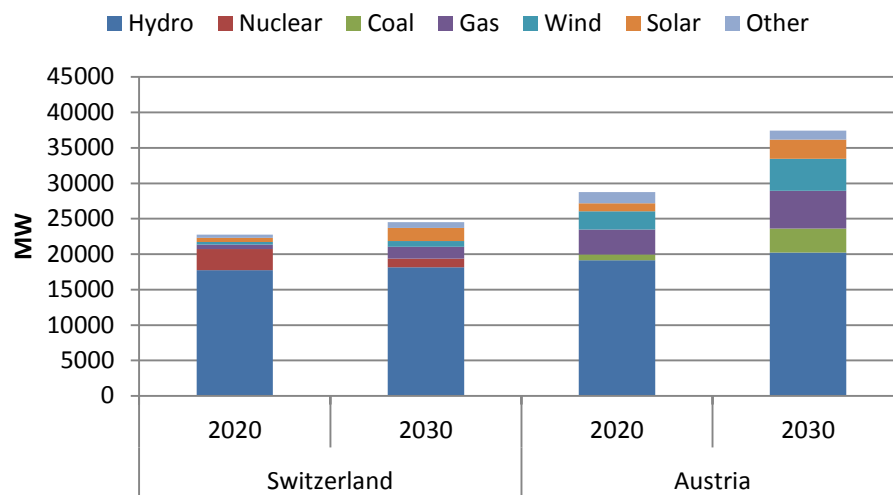
---

- Which scenarios are likely? How long will the low price period last?  
→ How many financial reserves do Swiss HP companies have?
- Is there substantial gain on the Intraday if all go in?
- What are the costs of flexible operation for turbines, infrastructure and trading?

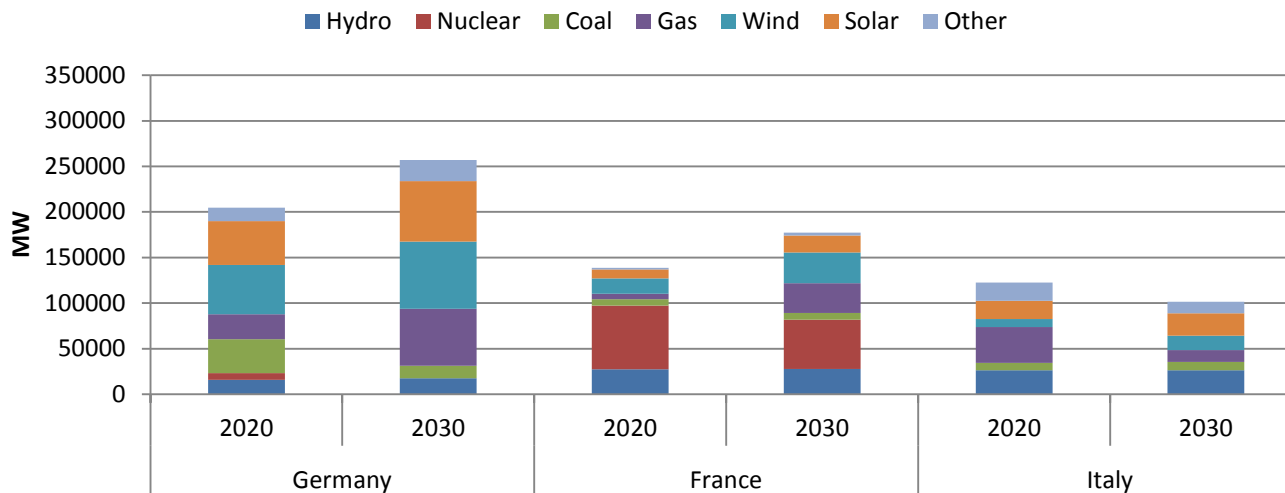
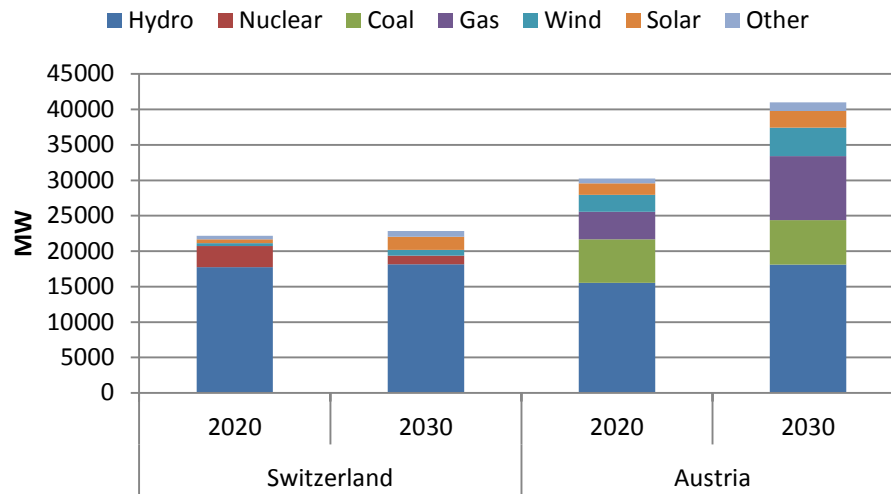
---

# Backup

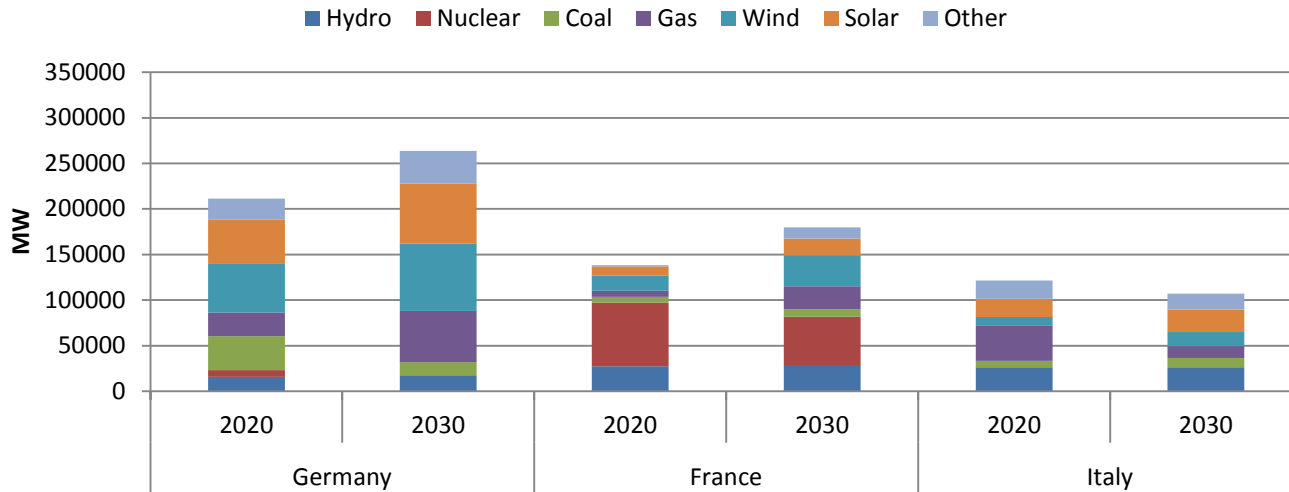
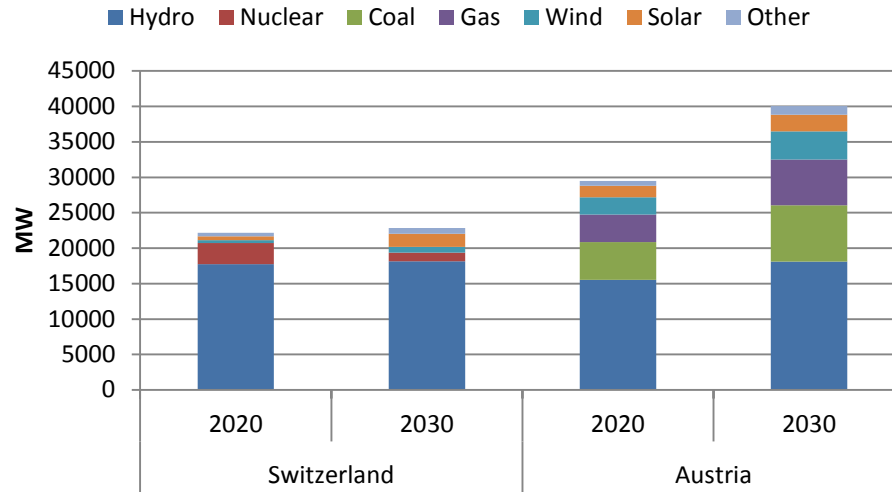
# EU Reference Scenario



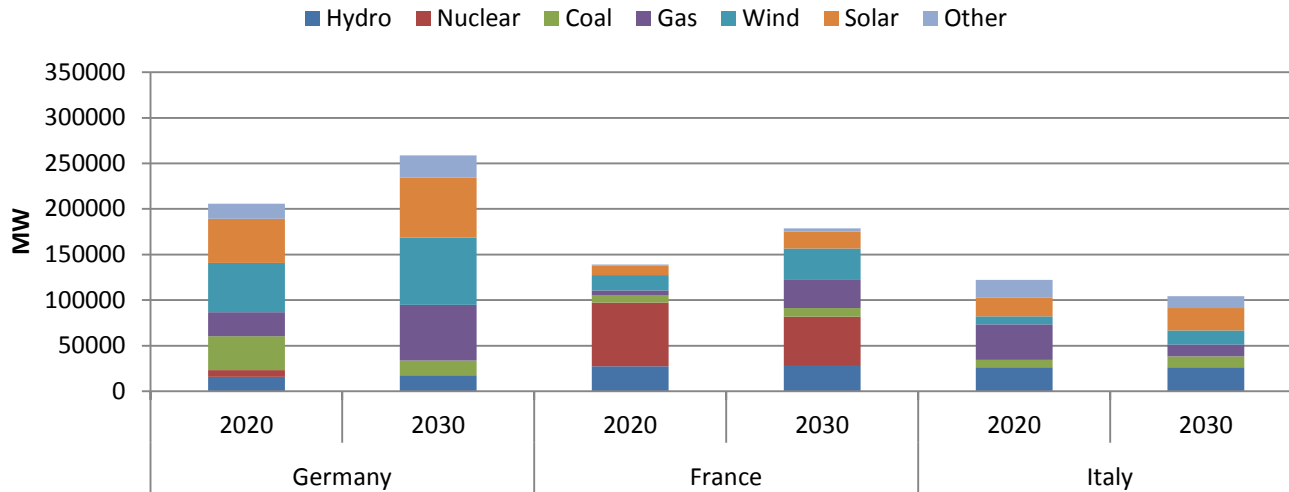
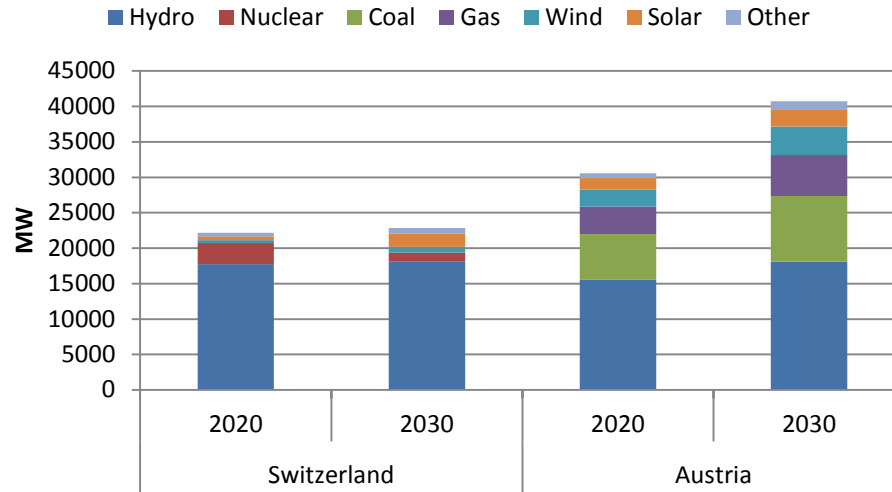
# Base EU Trend Scenario



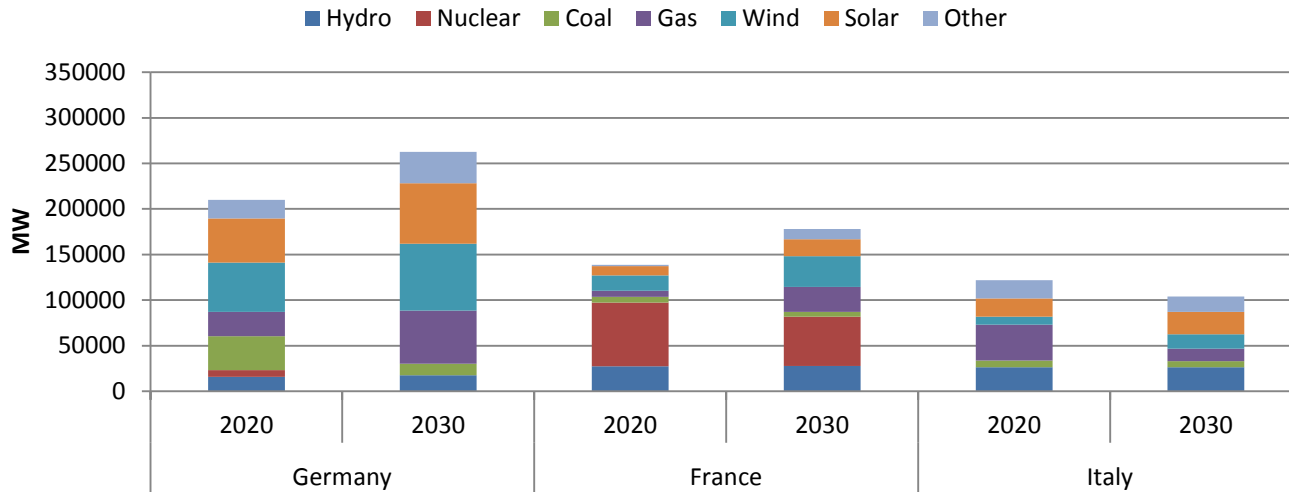
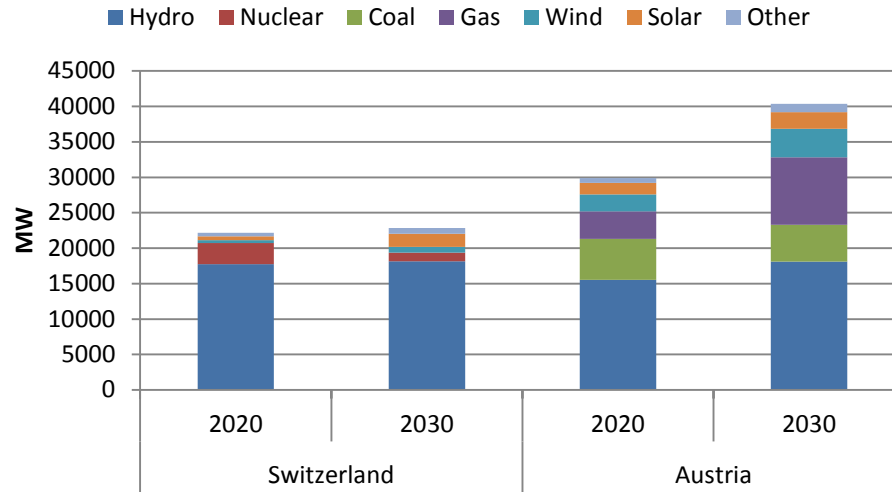
# Base Price 2015 Scenario



# Base Fuel High Scenario

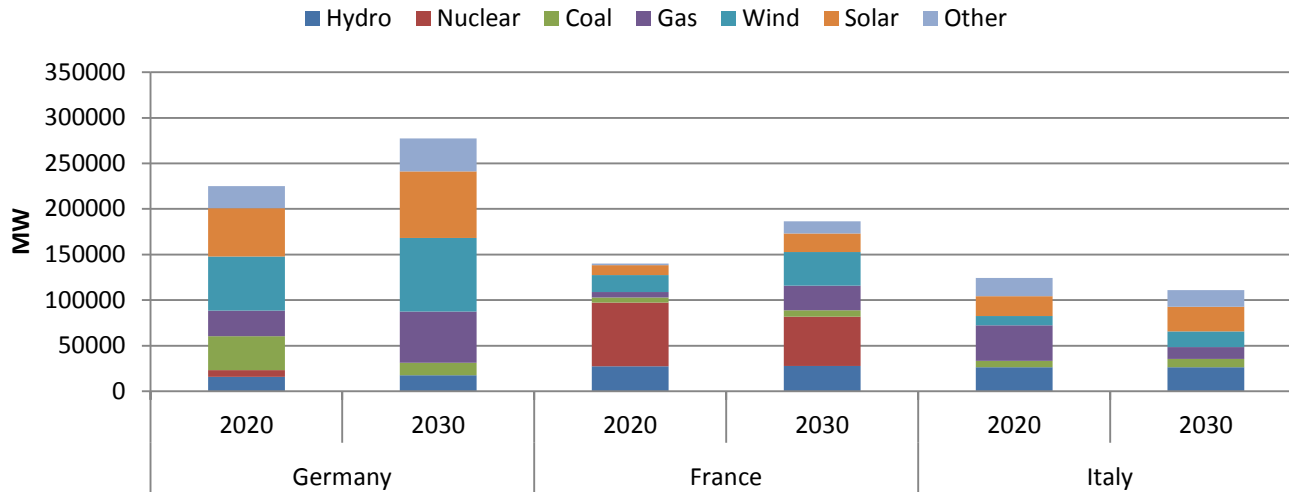
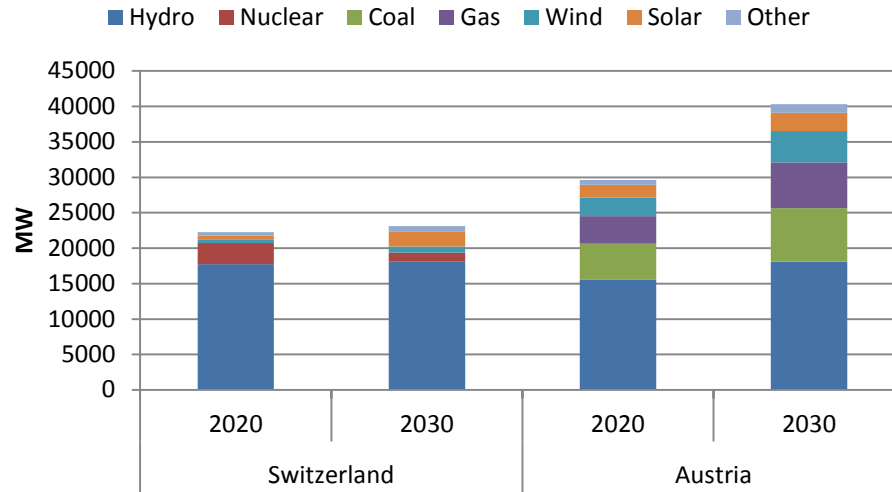


# Base Carbon High Scenario

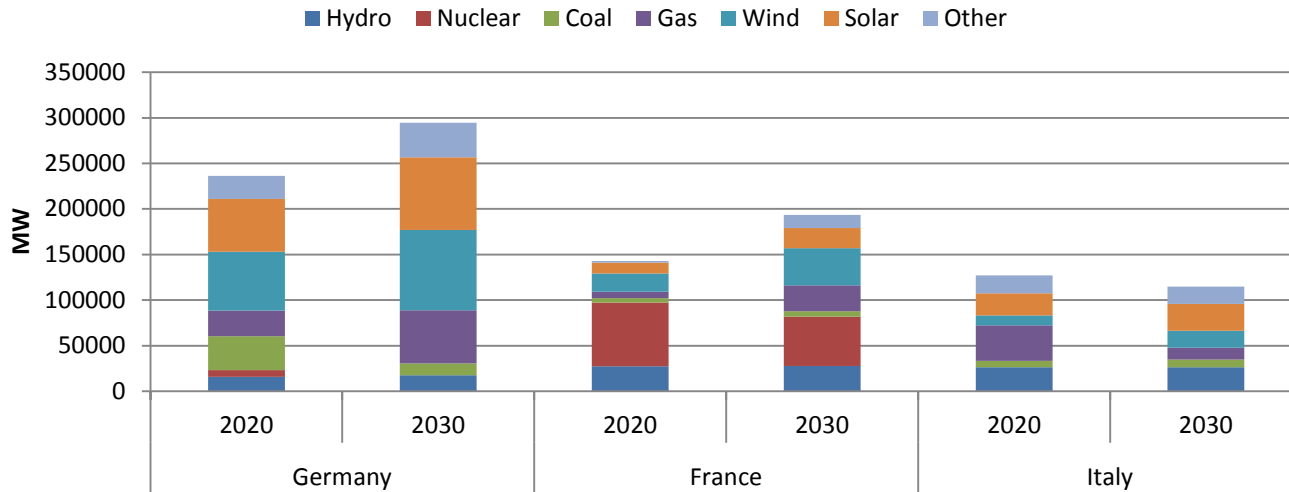
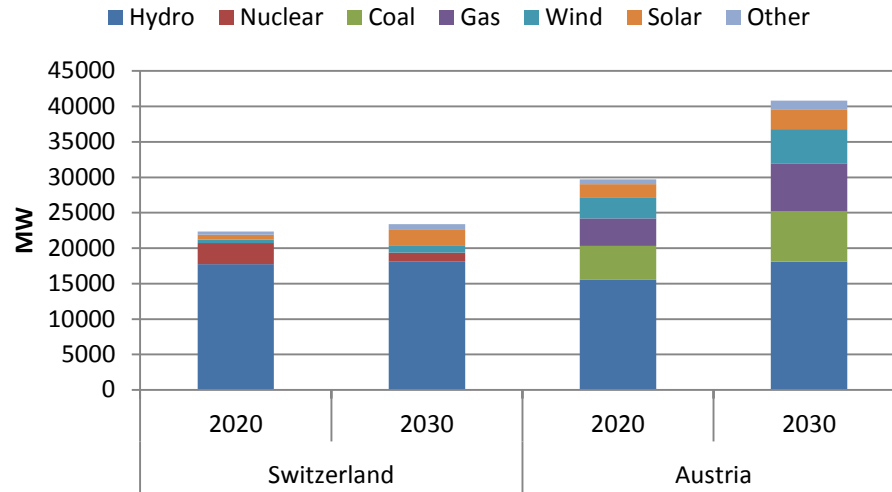




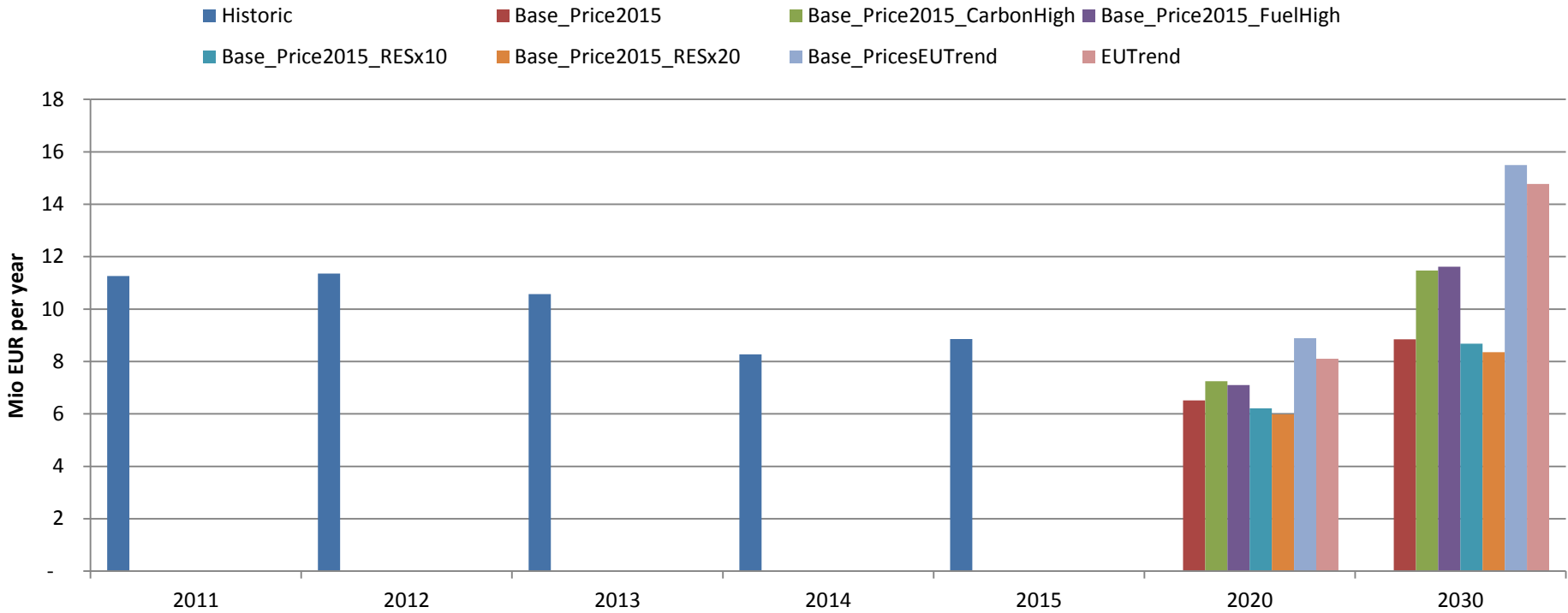
# Base RES x 10 Scenario



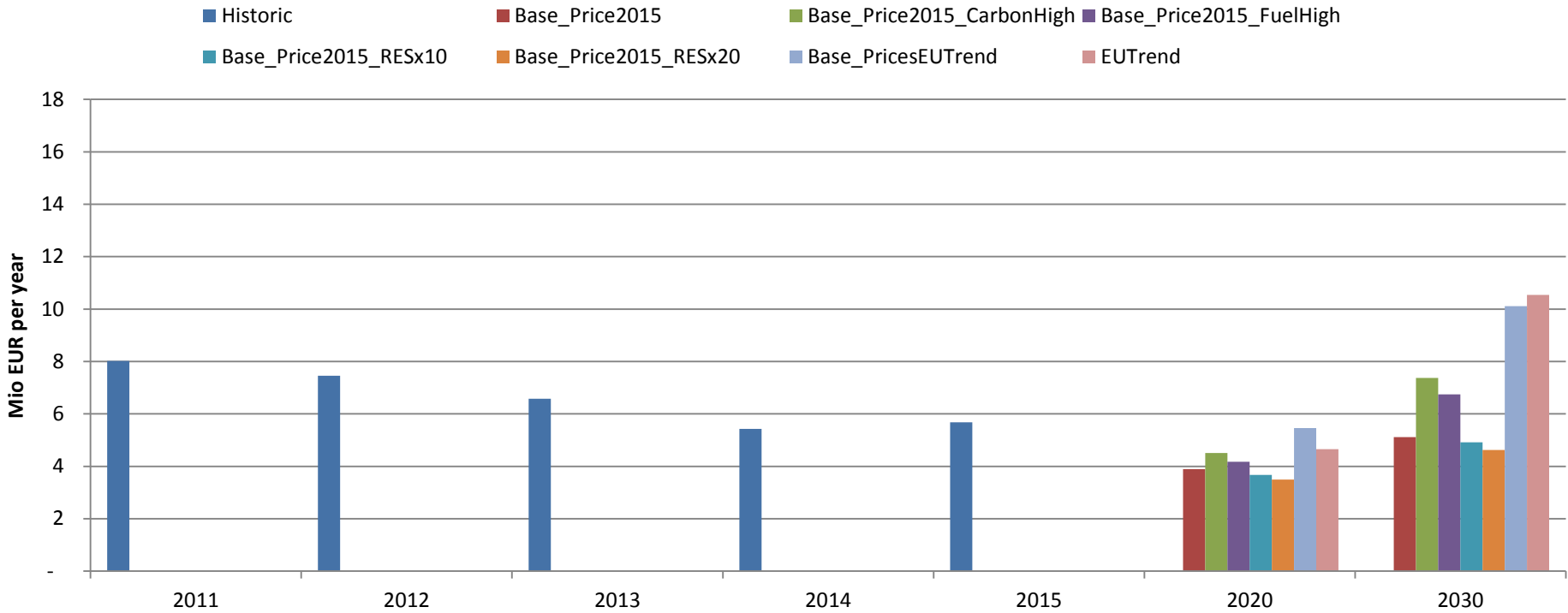
# Base RES x 20 Scenario



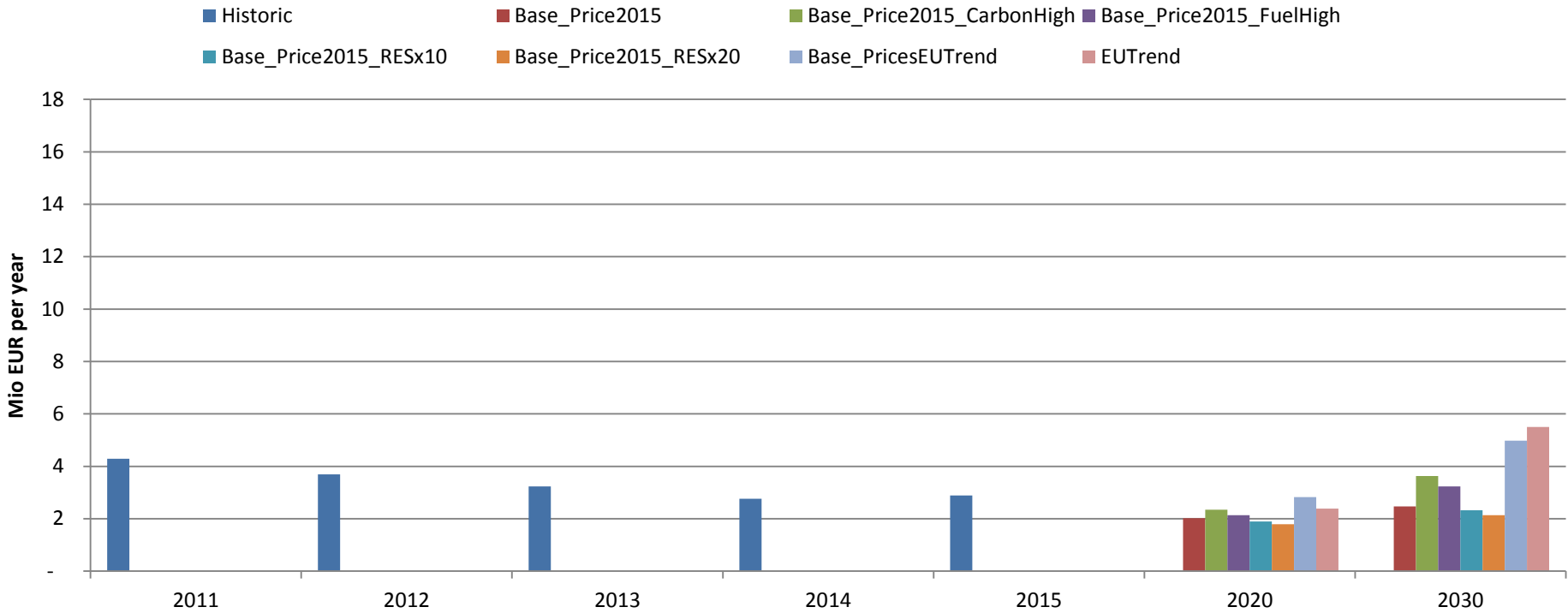
# Revenue Spot Market: big



# Revenue Spot Market : medium

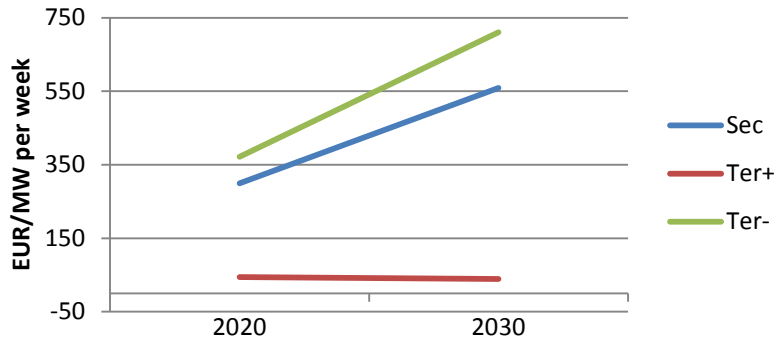


# Revenue Spot Market : small

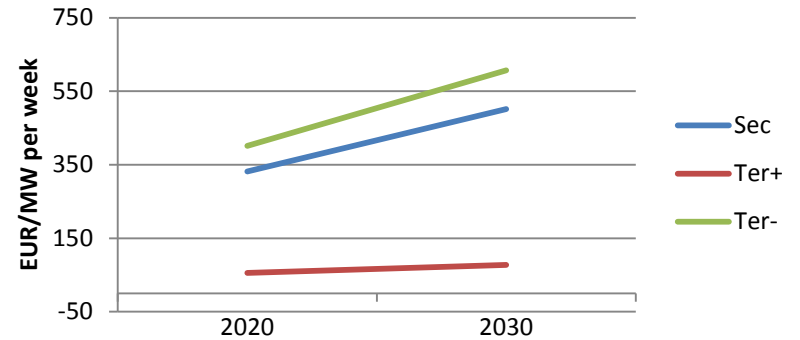


# Balancing Prices

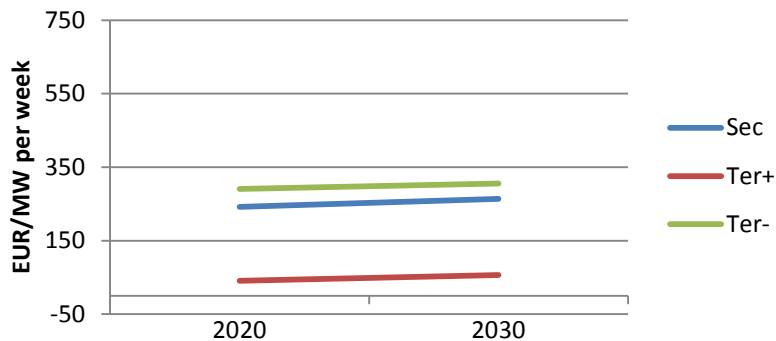
## EU Reference Scenario



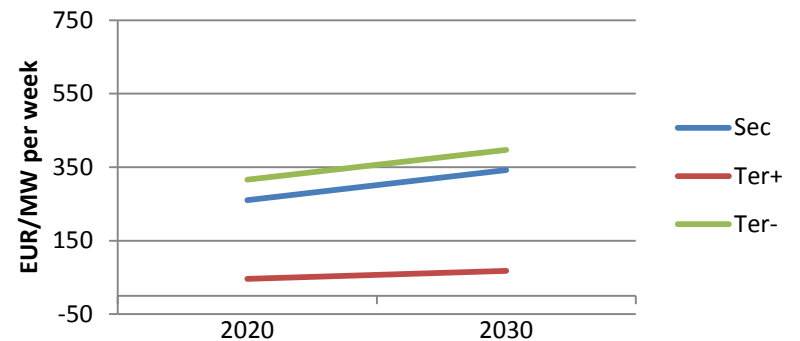
## Base EU Trend Scenario



## Base Price 2015 Scenario

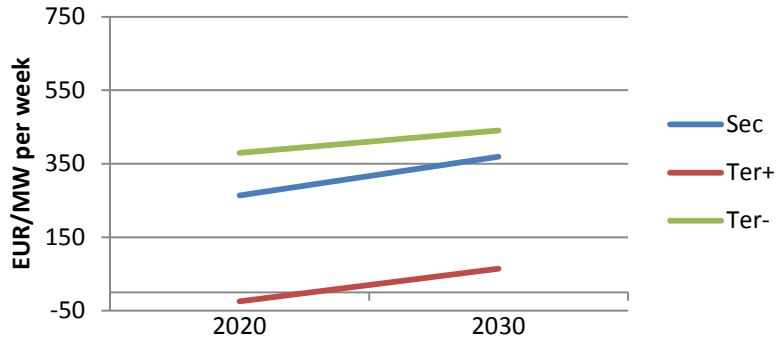


## Base Fuel High Scenario

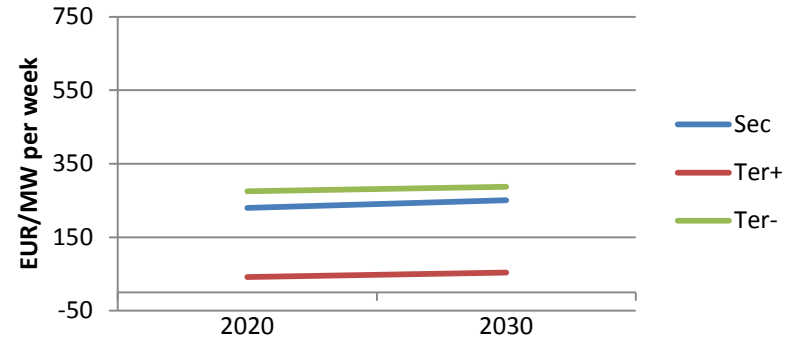


# Balancing Prices

## Base Carbon High Scenario



## Base RES x 10 Scenario



## Base RES x 20 Scenario

