Market4RES

Market design in the long term:

high shares of renewables penetration and security of supply

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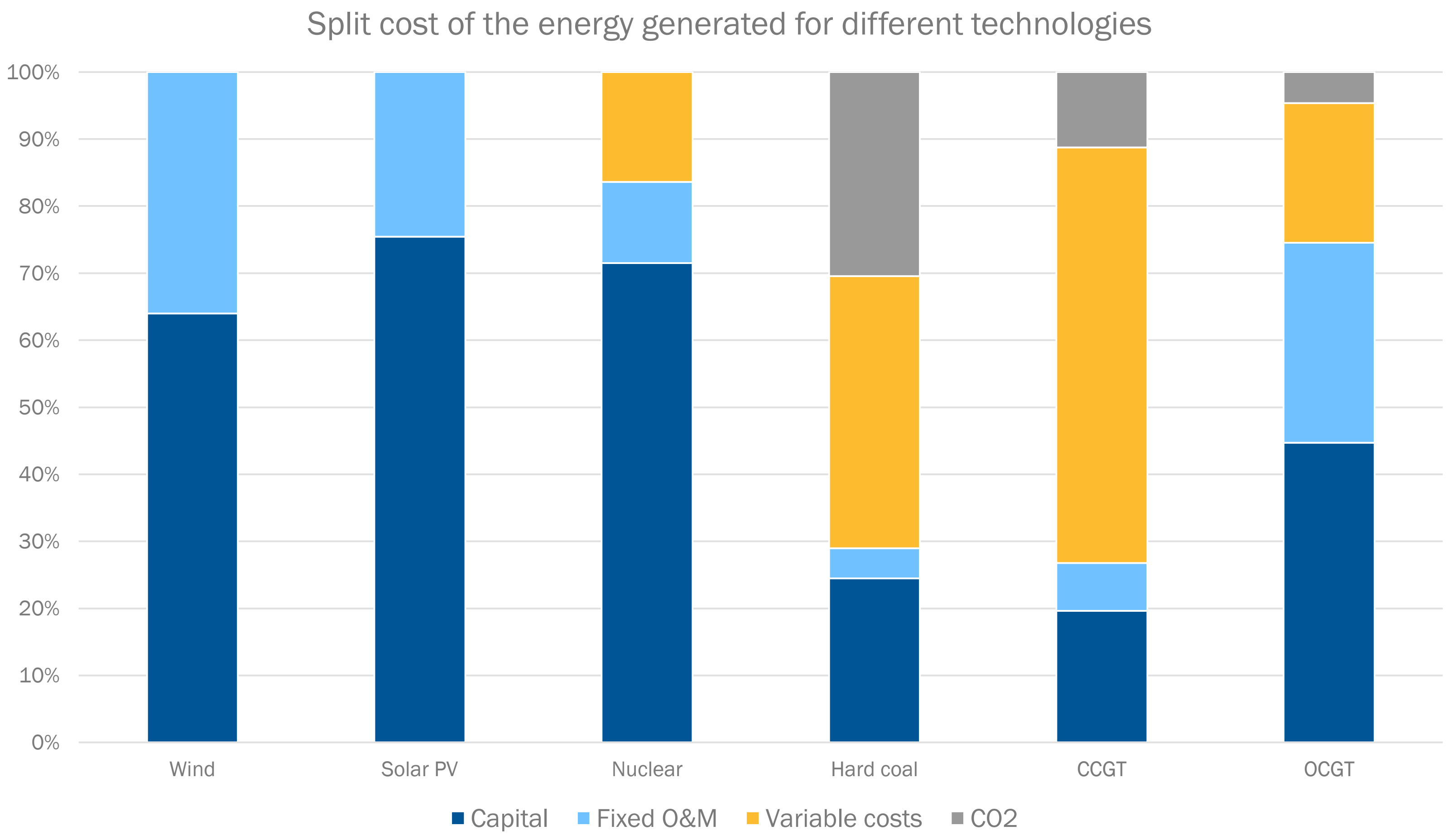
Challenges of a capital-intensive power system

Low-carbon and peaking technologies involve large proportions of fixed costs



Costs given usage factors in an optimized generation mix.
Cost hypotheses: EIA | CO_2 price: 30 €/t

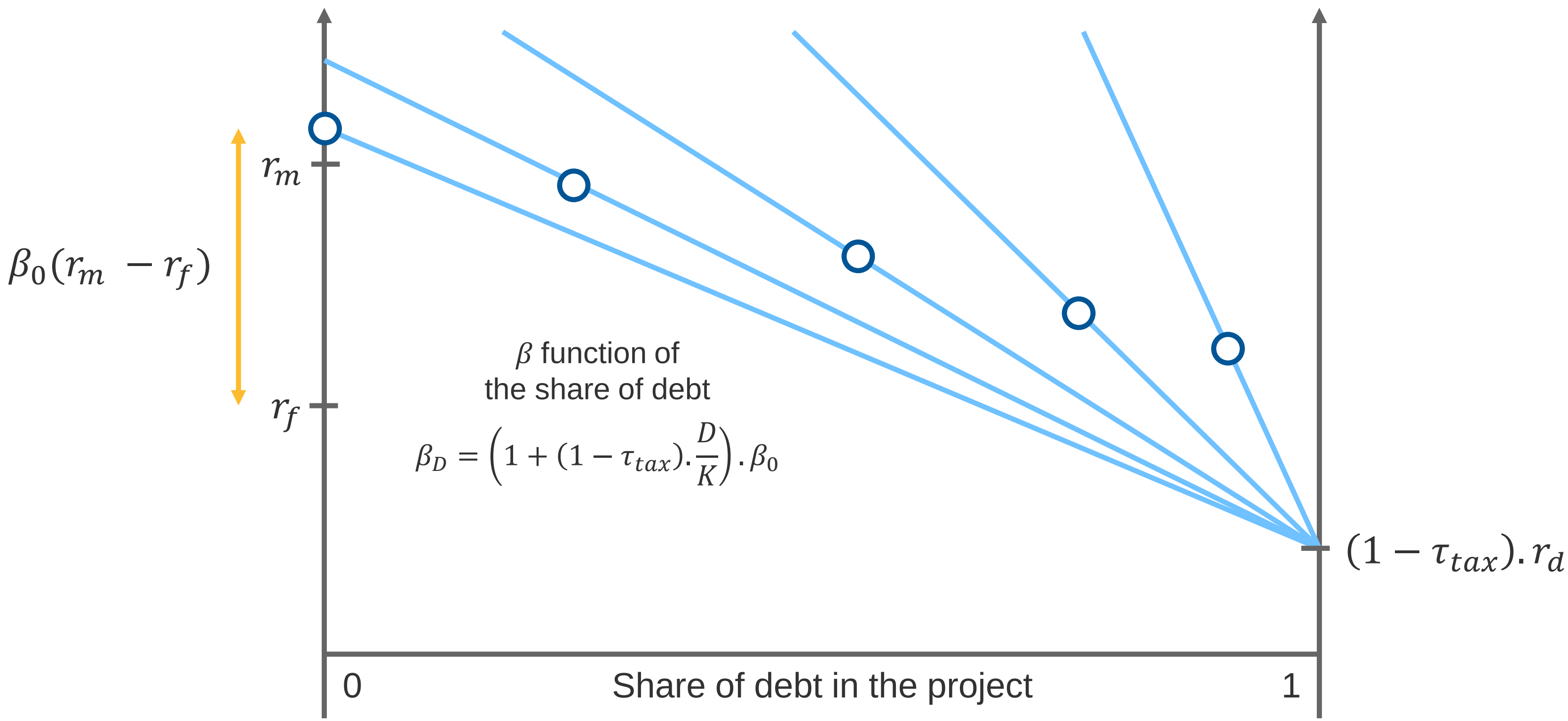
Market RES

The unit cost of capital-intensive technologies is much more responsive to the WACC level

Compared LCOE of wind, PV and CCGT as a function of the WACC (load factor: 50 %, CO_2 price: 30 €/t)
Data : Market4RES WP5 cost hypotheses

What about WACC?

$$WACC = \frac{K}{K+D}\left[r_f + \beta\left(r_m - r_f\right)\right] + \frac{D}{K+D}(1-\tau_{tax}).r_d$$



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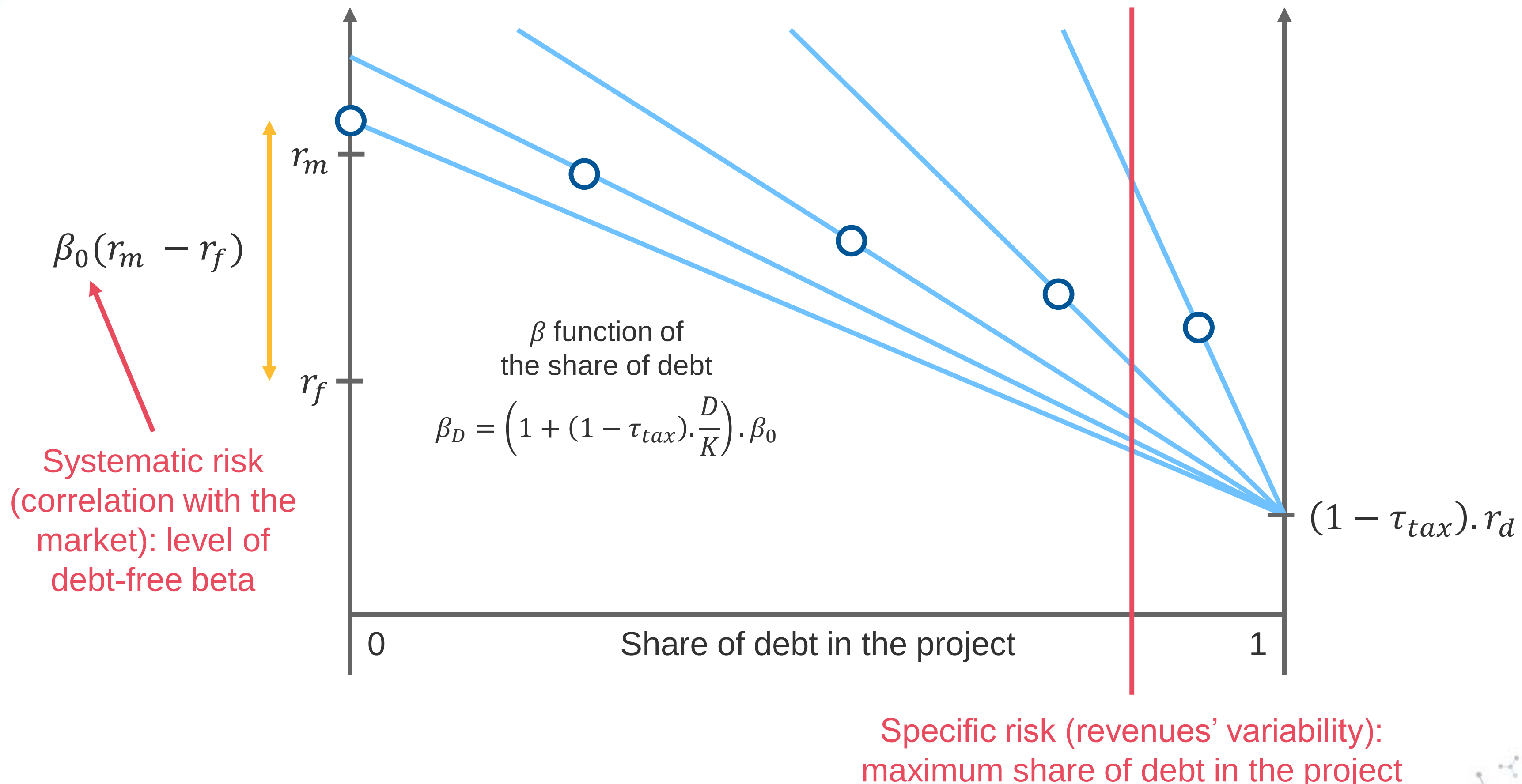


Decarbonizing power

is RES support here to stay?

Support schemes: how do they help?

Revenues

Costs

Investment support make projects more attractive by **reducing their costs**

Subsidy /MW upfront: only part of the cost remain at the expense of the producer

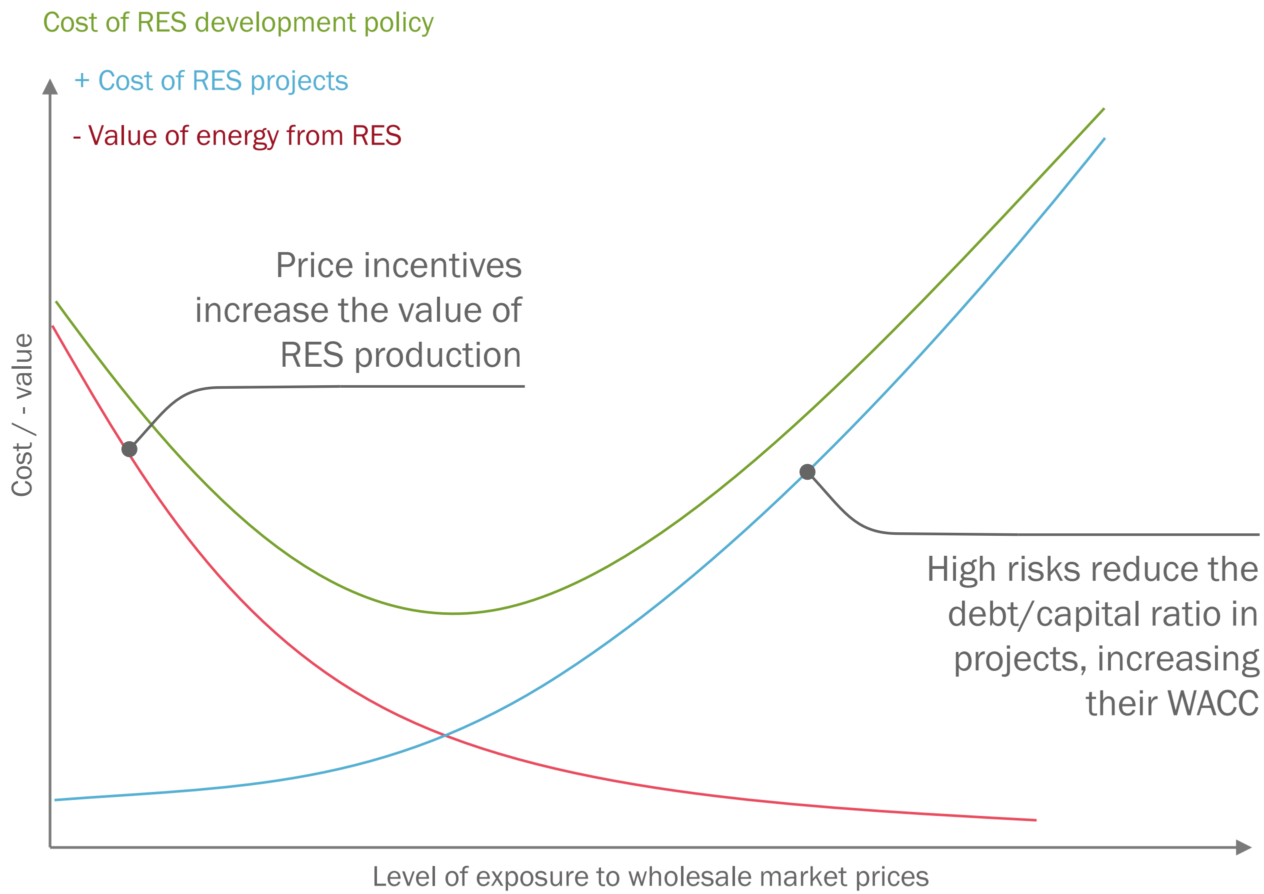
Financial guarantee: access to cheaper capital

Revenues

Costs

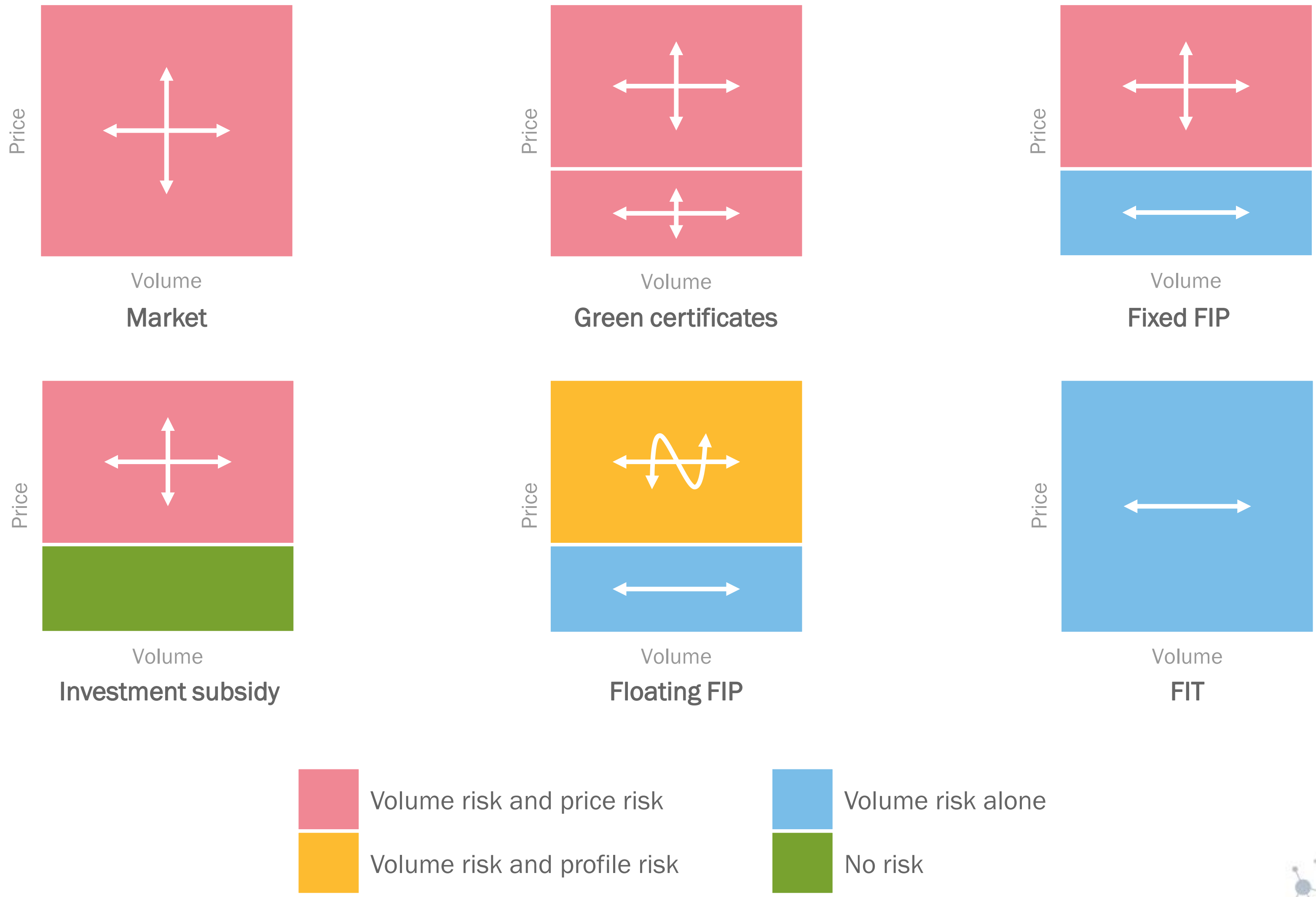
Operating aid (/MWh) make projects more attractive **by increasing their expected revenues and** often also by **making future revenues more certain**, therefore granting access to cheaper capital.

Arbitrage between risk and incentives



→ Here we focus on the **risk** part: the value of incentives is not explored ←

Market risks in RES projects,
according to the nature of the support scheme



Taking risk into account
WACC hypotheses used in WP5 study

WP5 'reference' and 'high' scenario hypotheses

Conventional technologies: **8 %**

RES technologies, computed based on conclusions from the Beyond 2020 European project

- **8 %** if all revenues come from the market (including ETS)
- **FIT: 6,2 %**

Beyond2020 unmodified hypotheses

Conventional technologies: **9,8 %**

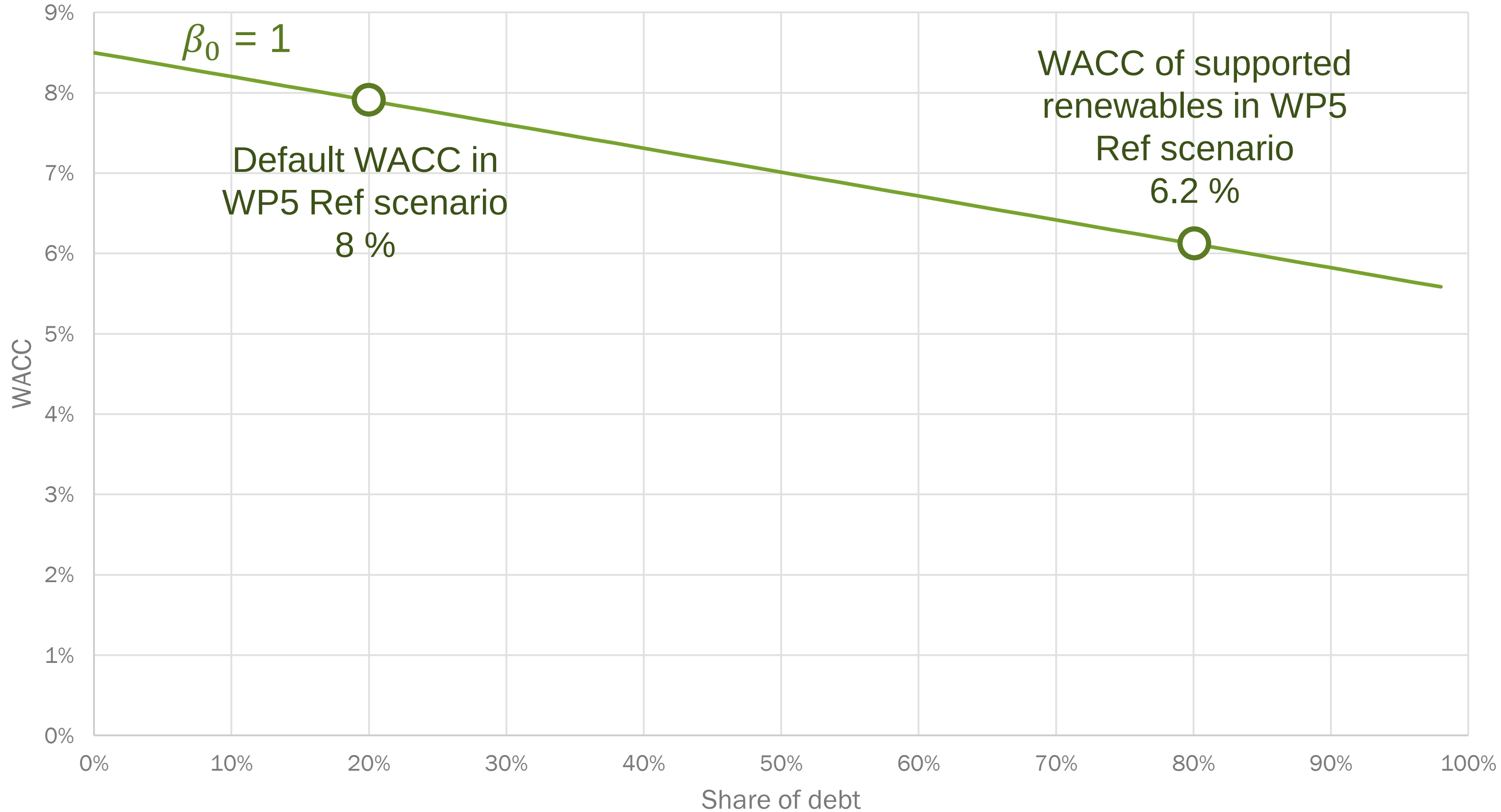
- **9,8 %** if all revenues come from the market (including ETS)
- **FIT: 7,5 %**

For sensibility analysis: "optimistic" hypotheses

Conventional technologies: 10 **%**

- **10 %** if all revenues come from the market (including ETS)
- **FIT: 5 %**

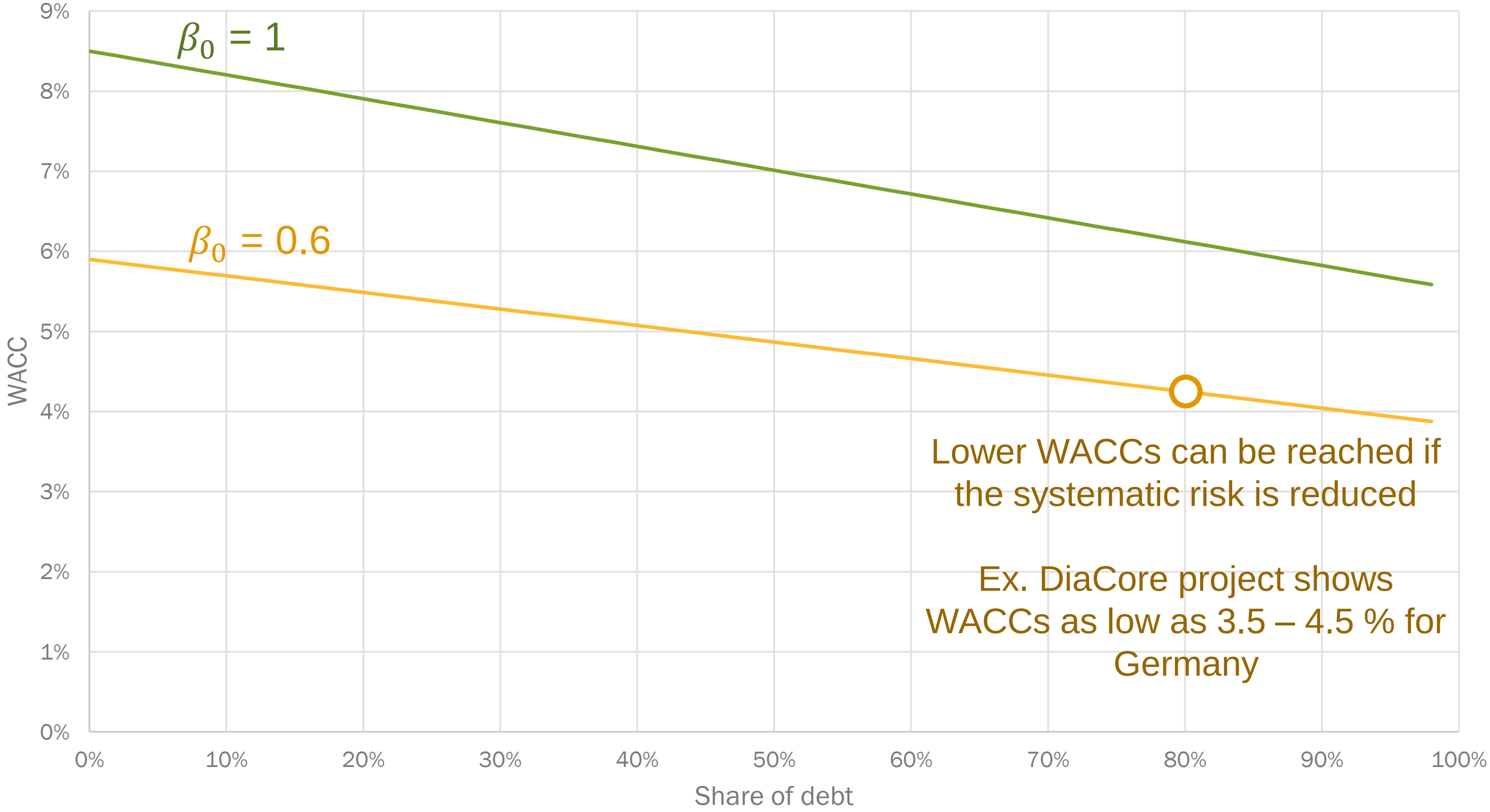
Back to WACC



The WACC computed given the following hypotheses:

r_f	r_m	r_d	Corp tax
2,0%	8,5%	2,0%	35%

Back to WACC



The WACC computed given the following hypotheses:

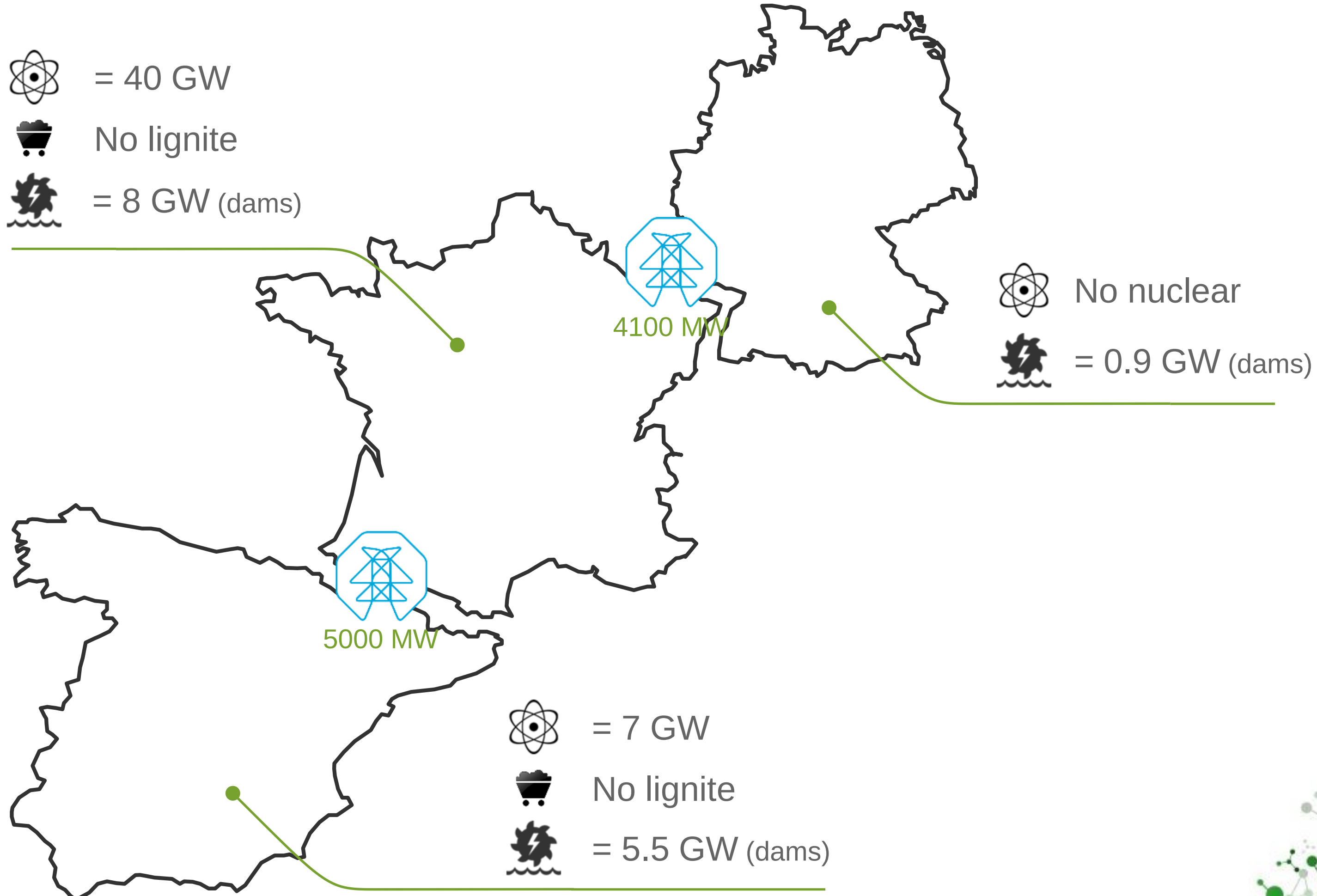
r_f	r_m	r_d	Corp tax
2,0%	8,5%	2,0%	35%

Modelling assumptions

Lignite
Hard coal

CCGT
OCGT

RoR
Dams



Methodology

Reference

WP5 **High RES** scenario:
95 €/tCO_2 + RES capacities
~ 250 MtCO_2 (= 150 g/kWh)

Cheapest mix to reach 250 MtCO_2 ?

Support scheme options

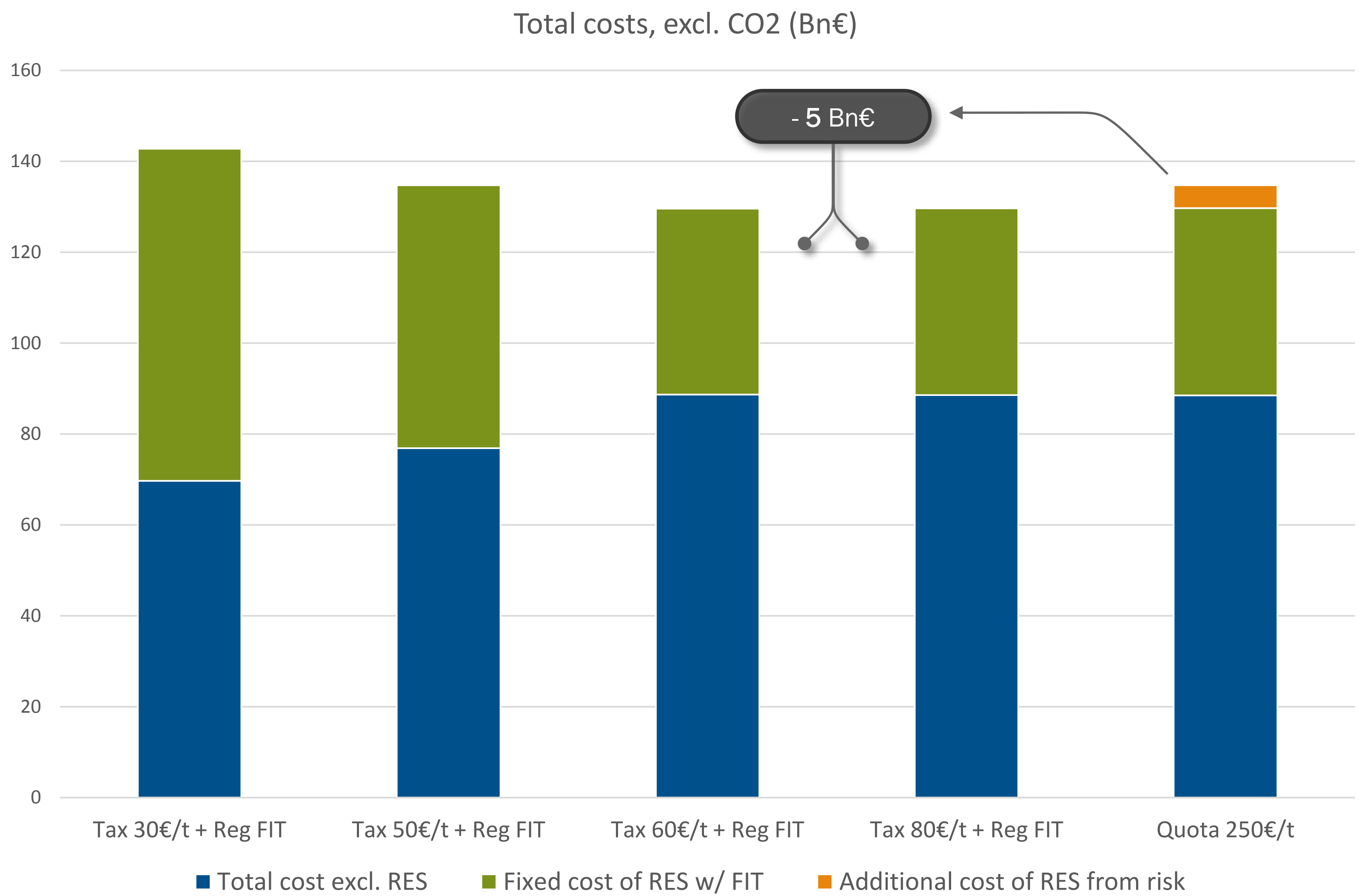
Market + CO2 price from Cap & Trade

Floating FIP or FIT

Market design variants

- CO2 price from cap & trade (ETS) and no RES target
- RES targets and support, no CO_2 price
- RES targets and support + CO_2 cost from a tax or a price floor on the ETS
  - Different CO_2 cost levels
  - National targets, technology-specific v. regional targets, technology-neutral

Results:
Carbon price + Regional, technology neutral target and support



Results:
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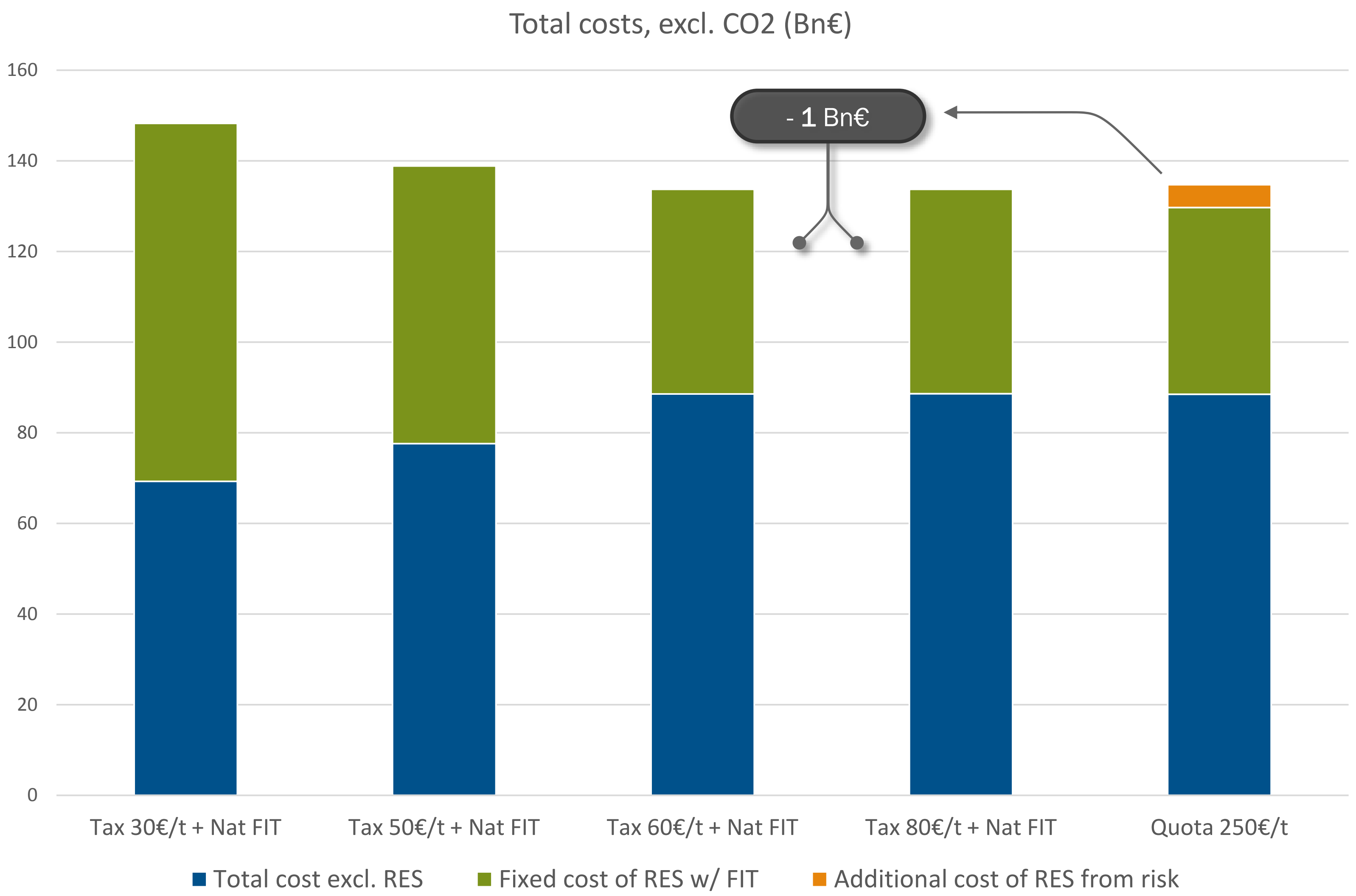
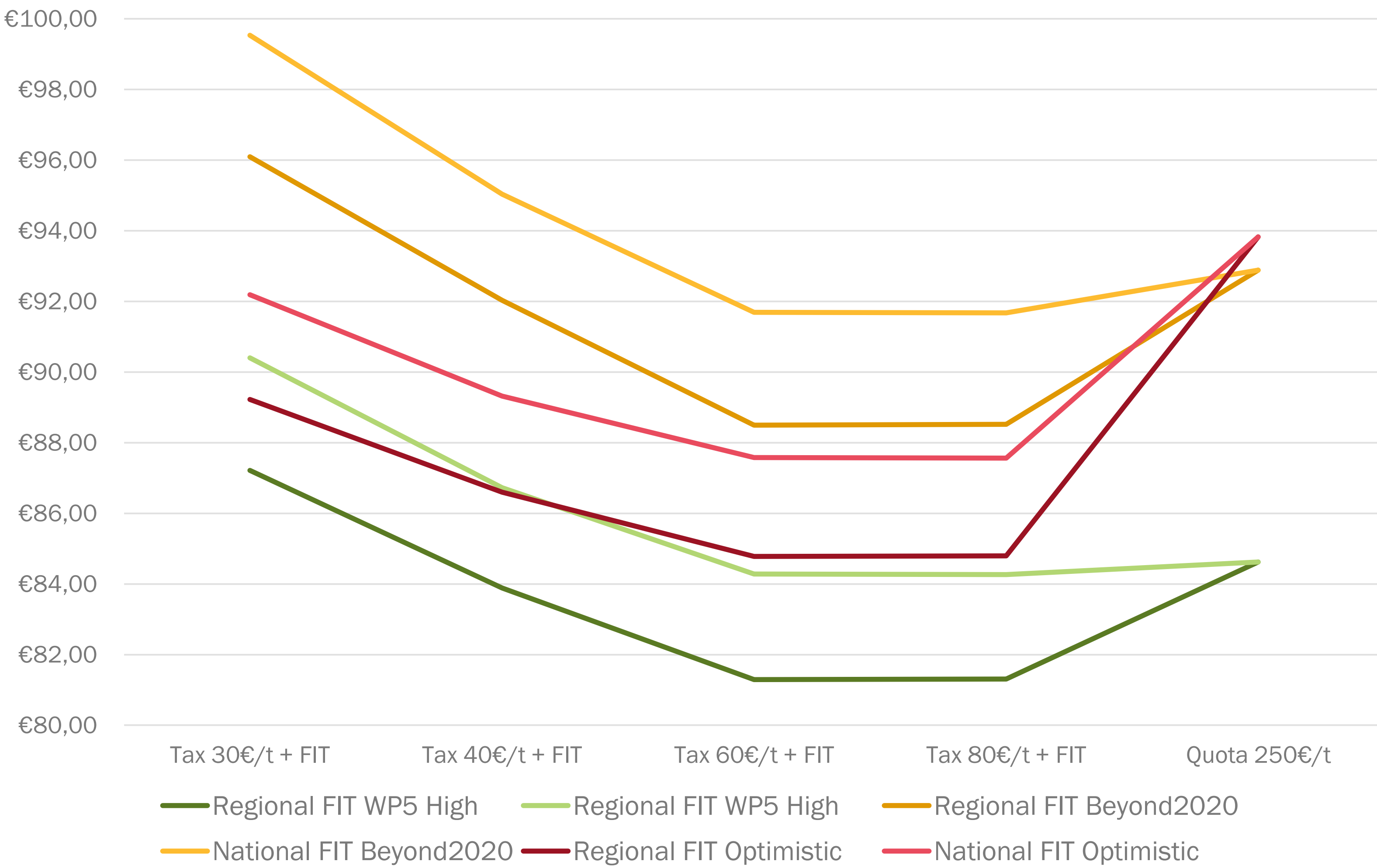


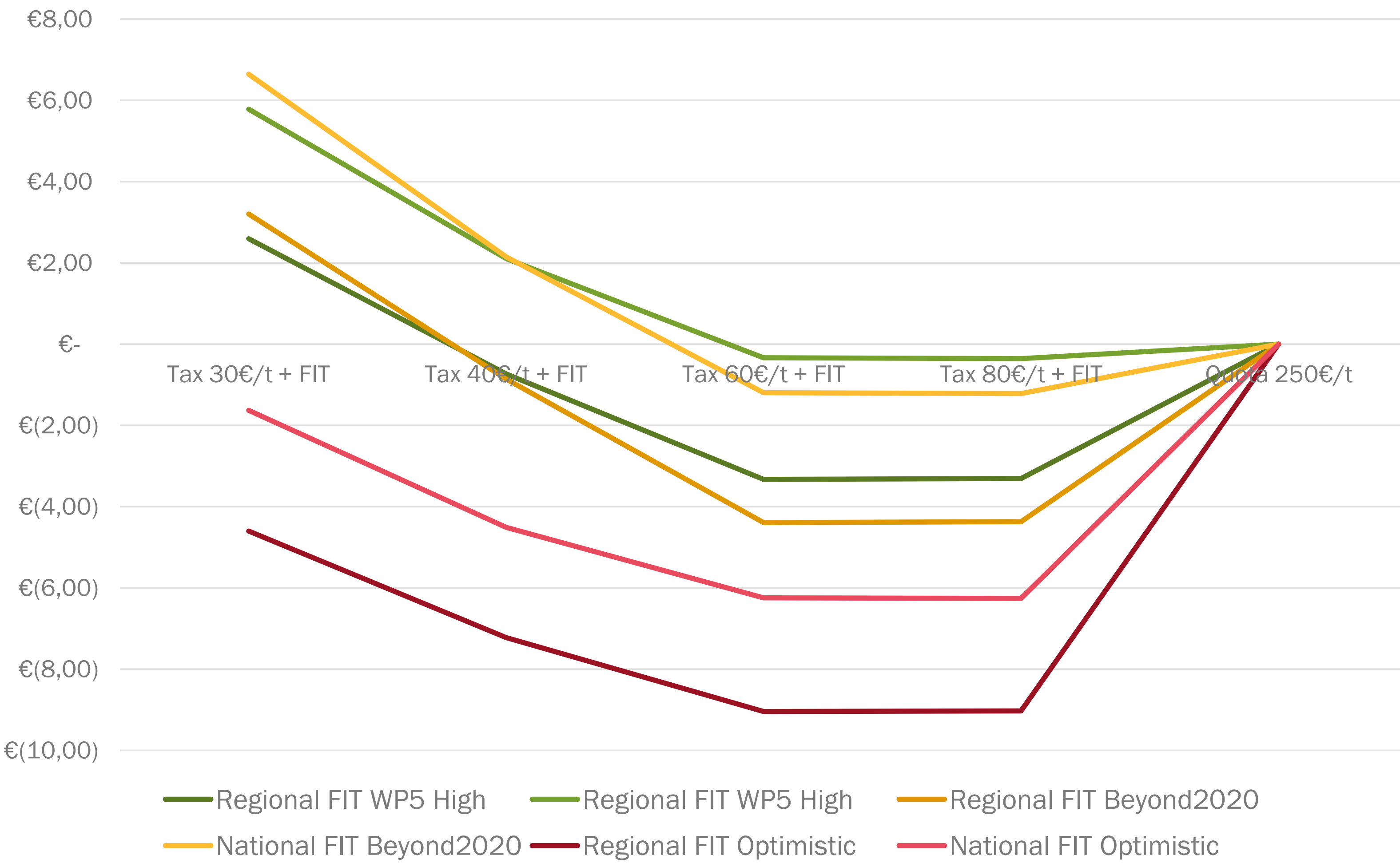
Results:

Comparison of unit cost of electricity



Unit cost of electricity as a function of the support mechanism's design

Results:
Comparison of unit cost of electricity



Unit cost of electricity as a function of the support mechanism's design, compared with the unit cost in the case of quotas

Efficiently tackling security of supply

in an internal market context

Capacity markets are a not so rare feature in the electricity industry

In Europe and around the world, plenty of capacity mechanisms (CM) have been implemented besides energy markets, or are planned to be implemented soon.

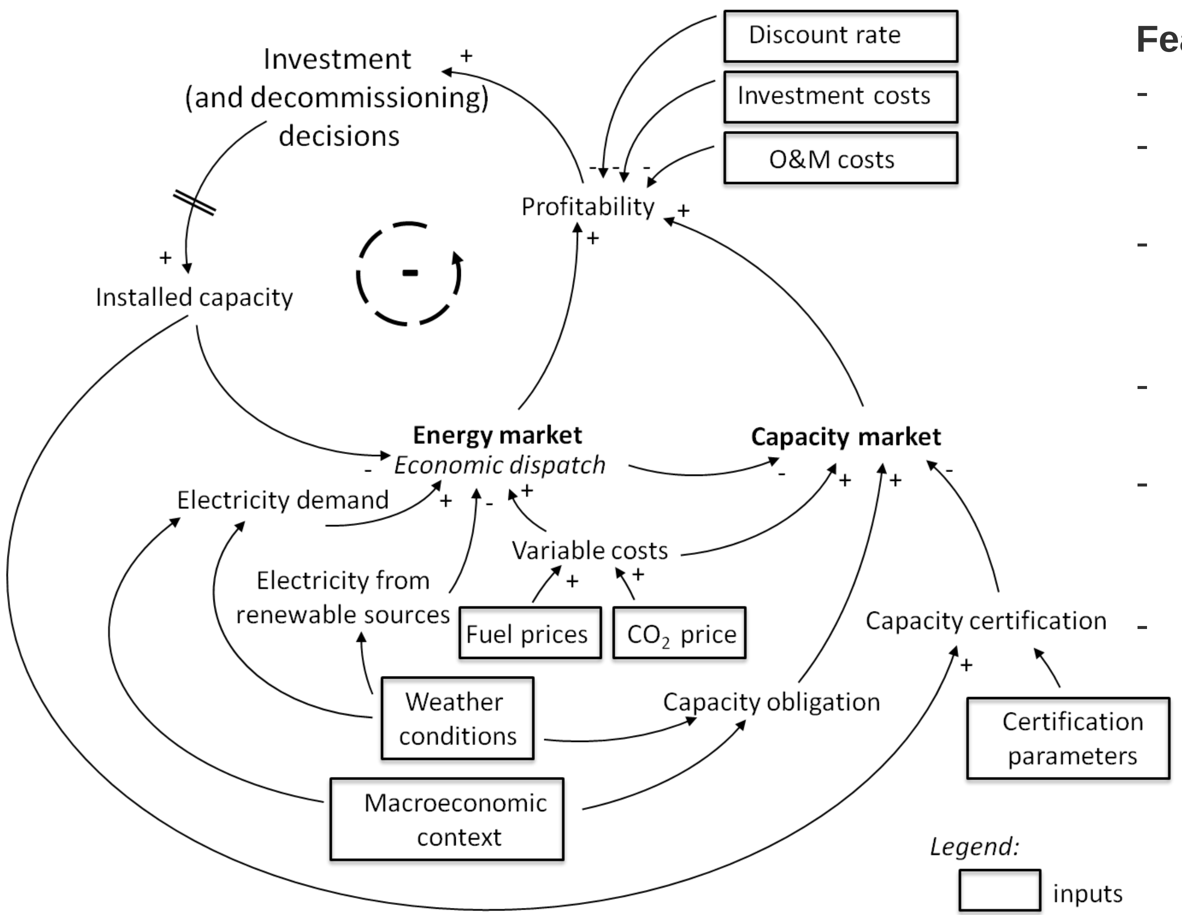
CM Precursors: Sweden, PJM in the USA, Colombia, Ireland, Spain, Italy, Portugal, and Chile

Recently implemented CM, building on previous experiences: Great Britain, France, Belgium

Design underway in: Poland, Denmark, Germany

EU Commission's sectorial survey interim report describes 28 capacity instrument in 11 surveyed countries!

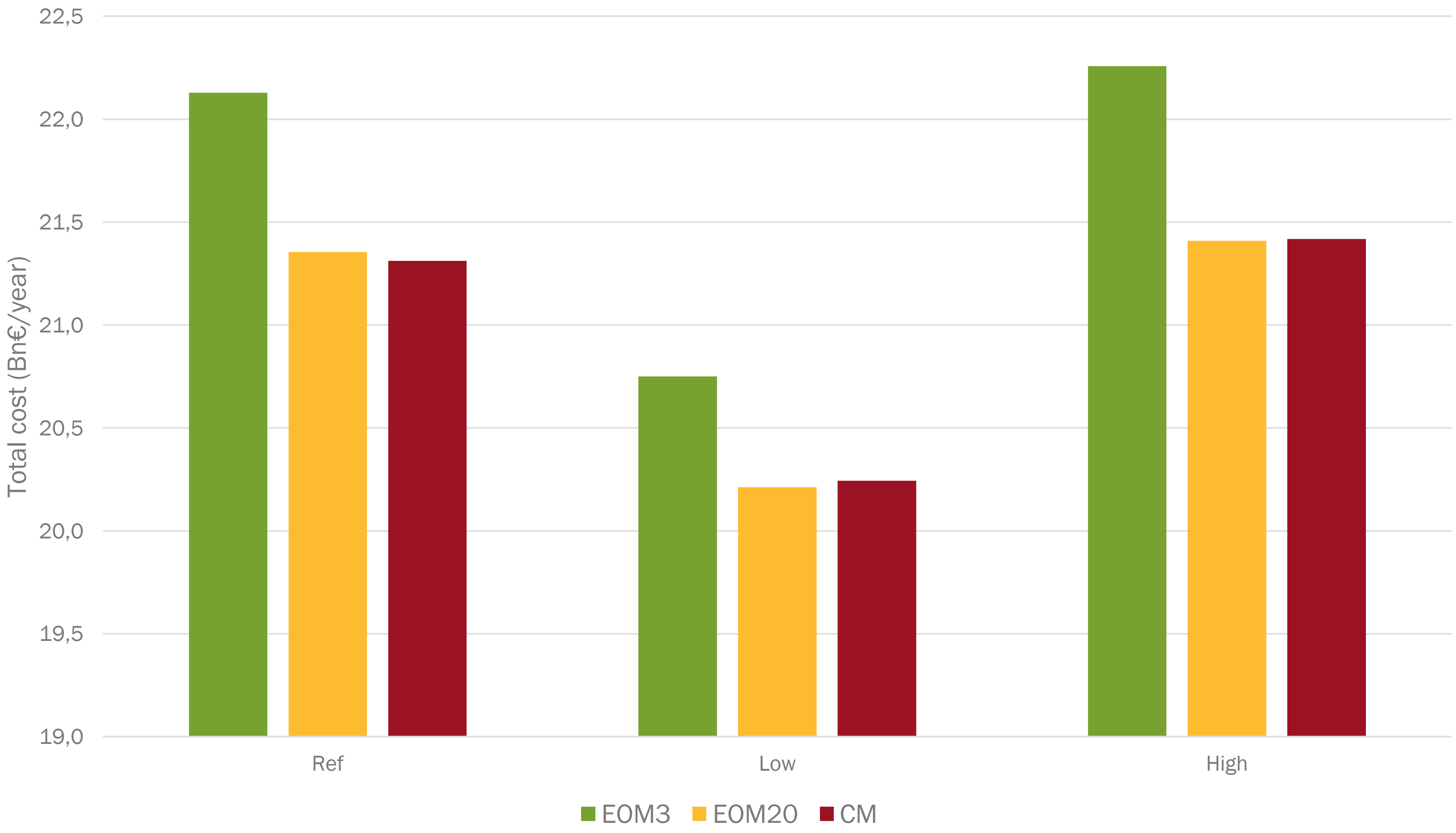
A modelling approach to investments under a capacity mechanisms



Features of the study

- France alone
- 2015-2030, given increase in RES capacities
- Investment decisions taken with a 5 years forward looking
- Withdrawal/mothballing decisions
- Capacity obligation computed on the basis of 3 hours of LOLD
- No risk aversion implemented

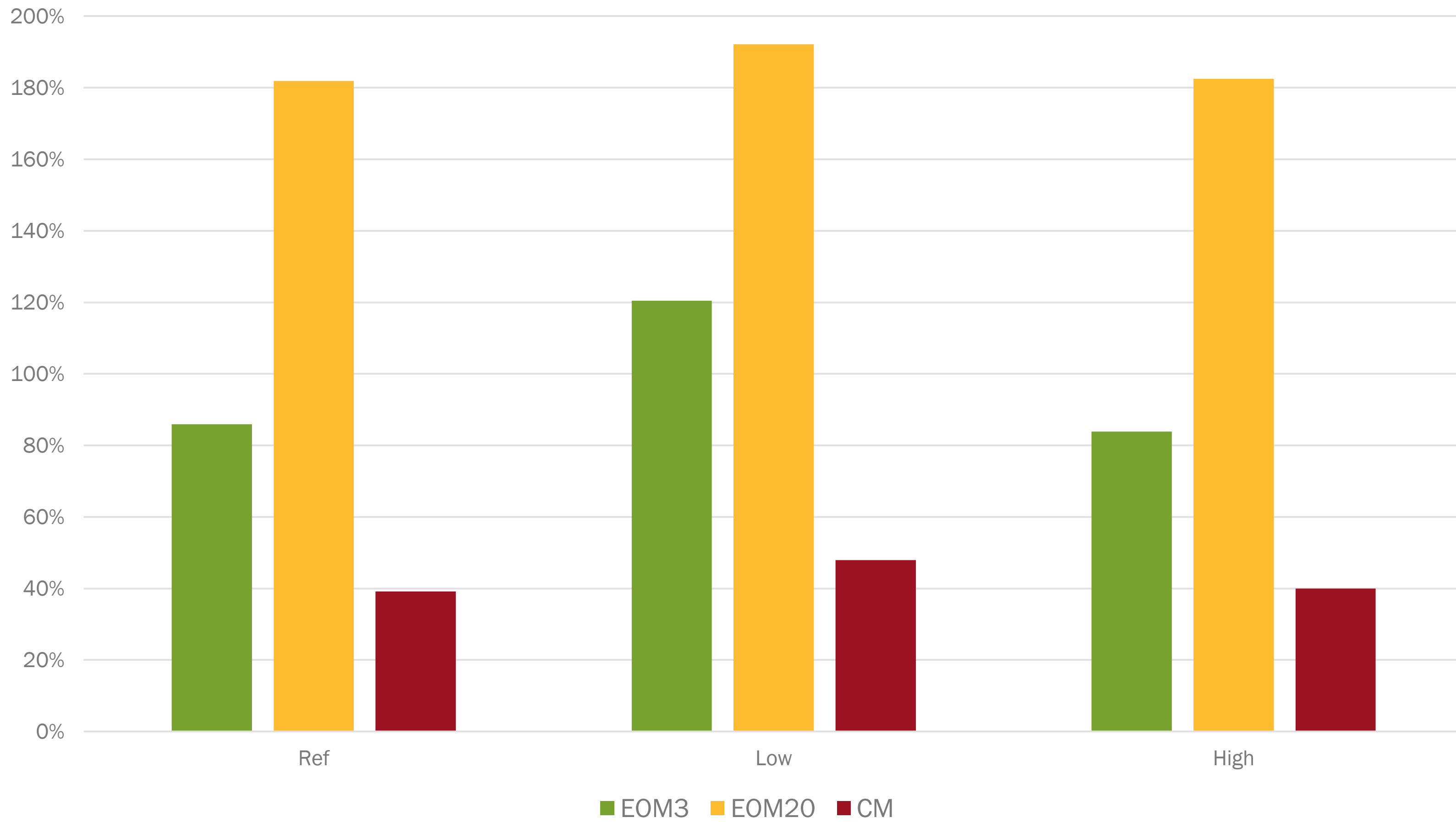
Capacity mechanisms to ensure security of supply…



Total costs including new investments for each scenario and market design, averaged over the 21 years of the simulation.

EOM20 and CM are equivalent (differences due to the granularity of investment decisions).
Important remark: the impact of risk on WACC is not taken into account here.

… while keeping the peaking plants' risk to an acceptable level



Variability of the revenues of a peaking generating unit across all weather scenarios (avg. over the 21 years of the simulation)

Risk mitigation through CM should result in a lower total cost with CM than under EOM20

Relevance of capacity mechanisms

→ A capacity mechanism

- Ensure adequacy and increases the social welfare when compared with an energy-only market with a 3000 €/MWh cap
- Reduces the risk of investments in peaking generating units in comparison to an energy-only market allowing very high electricity prices

→ Very high price cap on the market are a theoretical instrument. They should be perfectly efficient but in practice, it is very difficult to calibrate them and they bring a lot of risk.

The market design of capacity mechanisms

CMs designed in many different ways.
In WP3, we have:

- analyzed some of these mechanisms,
- and then adopted five design criteria, as follows:
  - the product,
  - whether the mechanism is price-based or quantity-based,
  - the party defining the quantity of the product to be purchased,
  - the counterparty purchasing the product in the mechanism,
  - cross-border participation of resources.


Market RES

Developments affecting the design of long-term markets

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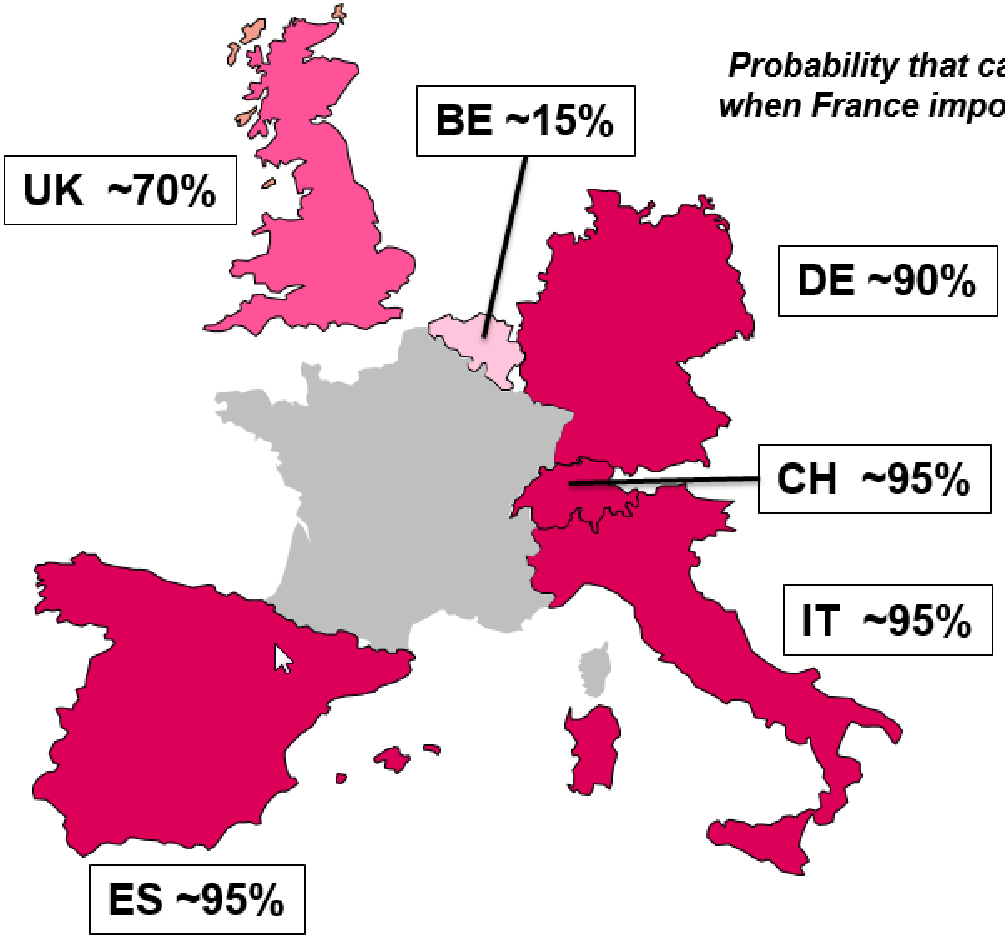
Cross-border capacity mechanisms

The merits of these options have been assessed in WP3

	Single and homogeneous CRM for all Europe	Statistical account of the interconnections	Participation of foreign capacities	Different isolated CRM
Efficiency	Fair	Fair / Good	Fair / Good / Very Good	Poor
Implementability	Poor	Good	Fair	Fair
Simplicity & transparency	Poor	Very Good	Fair	Very Good
Fainess	Good	Poor	Fair	Poor

Cross-border capacity mechanisms



Probability that capacity interconnection are saturated when France imports energy in case of supply shortage

Conclusion

- **Germany, Switzerland, Italy and Spain**:
NTC interconnections are limited flows in almost all situations

- **Great Britain**:
NTC interconnection is often reached

- **Belgium** :
Security of supply shortages conditions are similar

Cross-border capacity mechanisms

There are many options to implement X-border participation in capacity mechanisms, such as:

- **Implicit participation** of interconnections and of abroad capacities in the CM ;

  → Provides efficient economic incentives but only at national level, so limits perspectives of regional integration…

- Explicit participation of **abroad capacities** (including demand response) in the CM ;
- Explicit participation of **interconnections** in the CM ;
- Explicit participation of **both interconnections, abroad capacities** (including) demand response in the CM.

Cross-border capacity mechanisms

The theory:

explicit participation of both interconnections, abroad capacities (including demand response) in the CM should be the target

To put this option into force, some legal and economic matters remain to be solved at a national and European level.

For instance, the case of simultaneous supply shortage in two countries raises governance issues about the effective contribution of abroad generators or demand response.

The verification of the services provided by foreigner generators and demand response brings up legal and technical issues. Thus, the effective contribution of the capacities to one national security of supply or to the other is difficult to evaluate.

Cross-border capacity mechanisms

A target mechanism could rest upon:

The allocation of access rights to interconnection capacities to some producers or demand response operators installed outside of the national network

→ Such access rights are essential to the participation of those capacities to the national security of supply,

The definition of certificates for generators, or demand response installed outside of the national network.

Cross-border capacity mechanisms

The 42nd article of the 2009/72/CE directive allows member States to take extreme action in case of necessity…

"In the event of a **sudden crisis in the energy market** and where the physical safety or security of persons, apparatus or installations or system integrity is threatened, a Member State may temporarily take the **necessary safeguard measures**. Such measures **must cause the least possible disturbance in the functioning of the internal market** and must not be wider in scope than is strictly necessary to remedy the sudden difficulties which have arisen.

… nevertheless, the directive n°2005/89/CE strengthens that member states could not in this case be inequitable between national and international contracts:

« In taking the measures referred to in Article 24 of Directive 2003/54/EC and in Article 6 of Regulation (EC) No 1228/2003, Member States **shall not discriminate between cross-border contracts and national contracts**. »

Cross-border capacity mechanisms

A pragmatic approach would consist in developing an explicit participation of interconnections only

- solution selected in Great Britain
- contains a good balance between:
  - the necessity of taking into account international help to the security of supply
  - and the legal and technical issues.

This choice has been analyzed in the same way by the European Commission (SA.35980 – C (2014) 5083):

"The Commission recognizes the complexities of effectively allowing cross border participation in a capacity mechanism. The Commission welcomes the commitment of the UK to facilitate the participation of interconnectors [...]. The Commission recalls that the EEAG require schemes to be adjusted in the event that common arrangements are adopted to facilitate cross border participation in such schemes."

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Results, event calendar and all related news can be found on: www.market4RES.eu

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Thank you very much for your attention