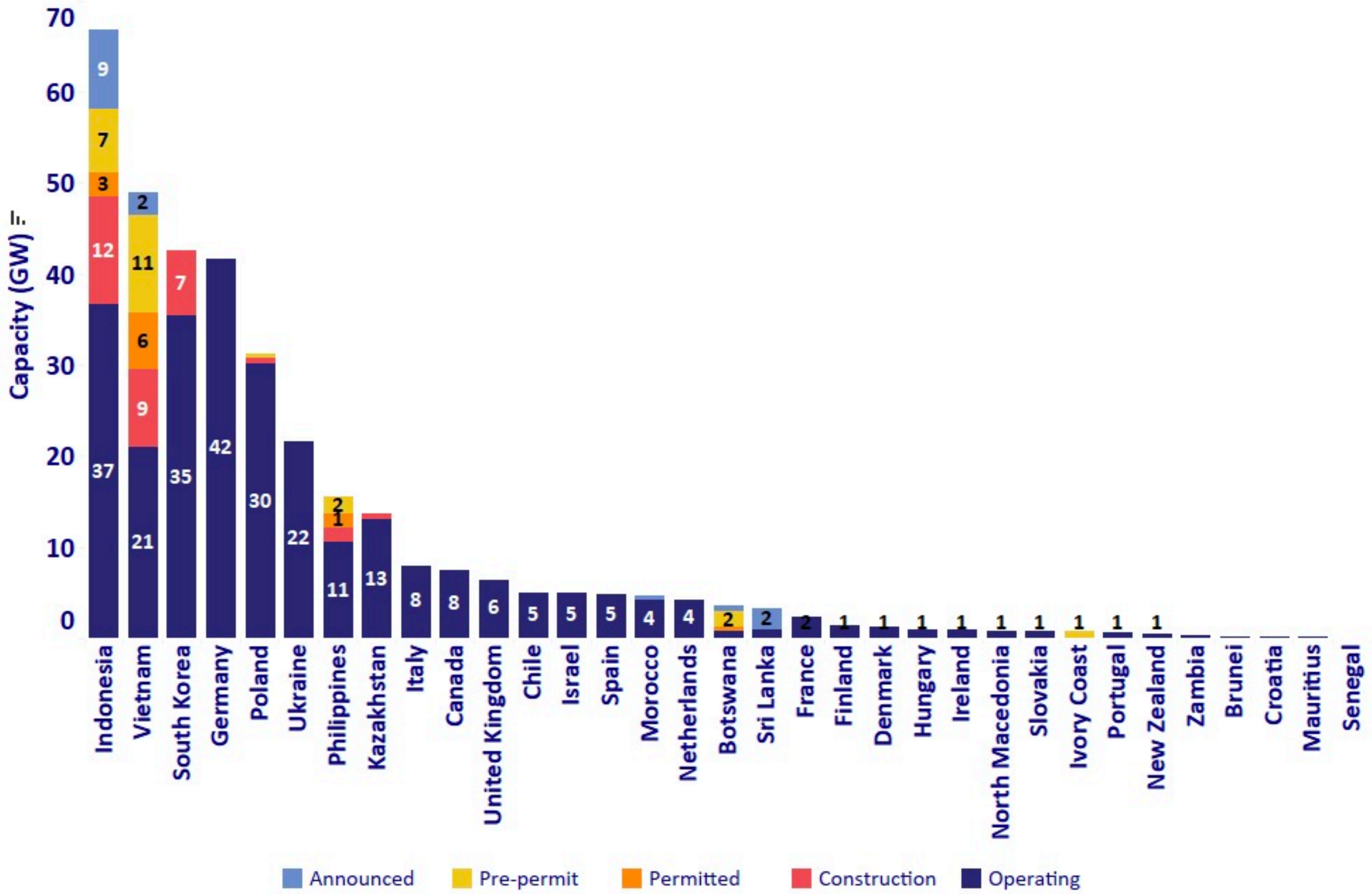


# Transferring lessons for phasing out coal

Nacke and Jewell, 2021

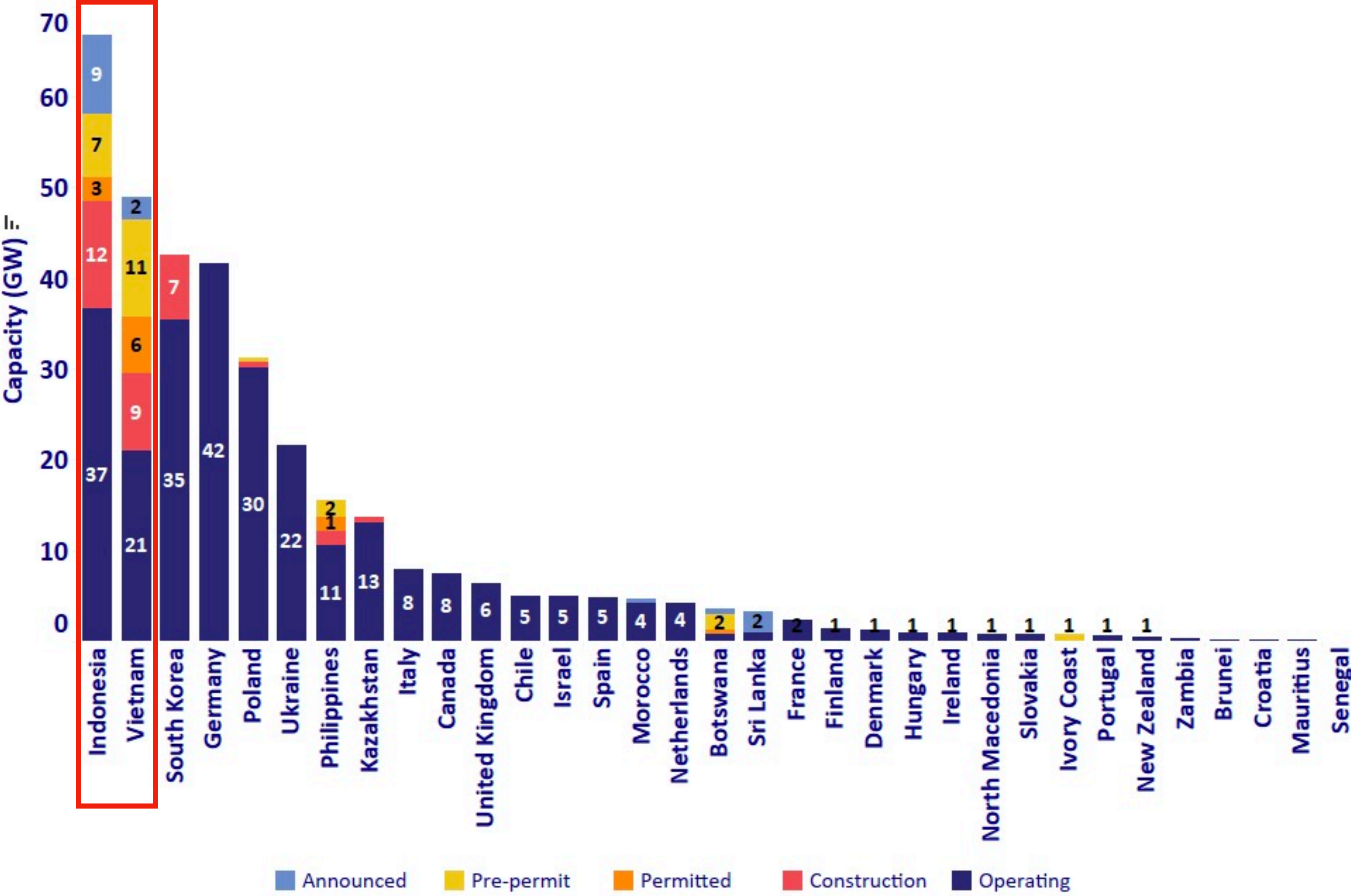


# Countries that are signatories to the Global Coal to Clean Power Country Statement at COP26



Source: E3G Analysis of Global Energy Monitor Global Coal Plant Tracker data, as of July 2021.

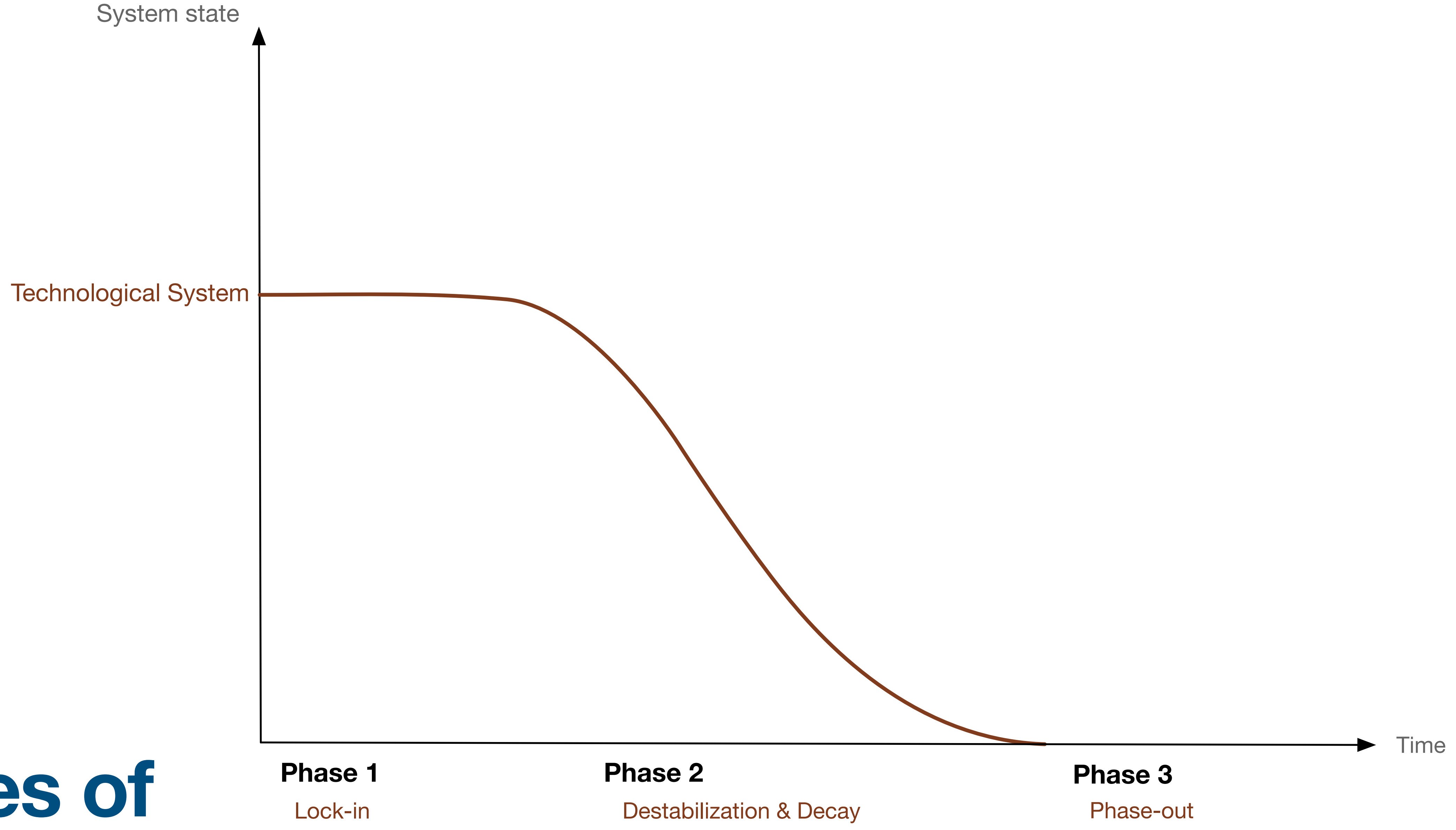
# Countries that are signatories to the Global Coal to Clean Power Country Statement at COP26



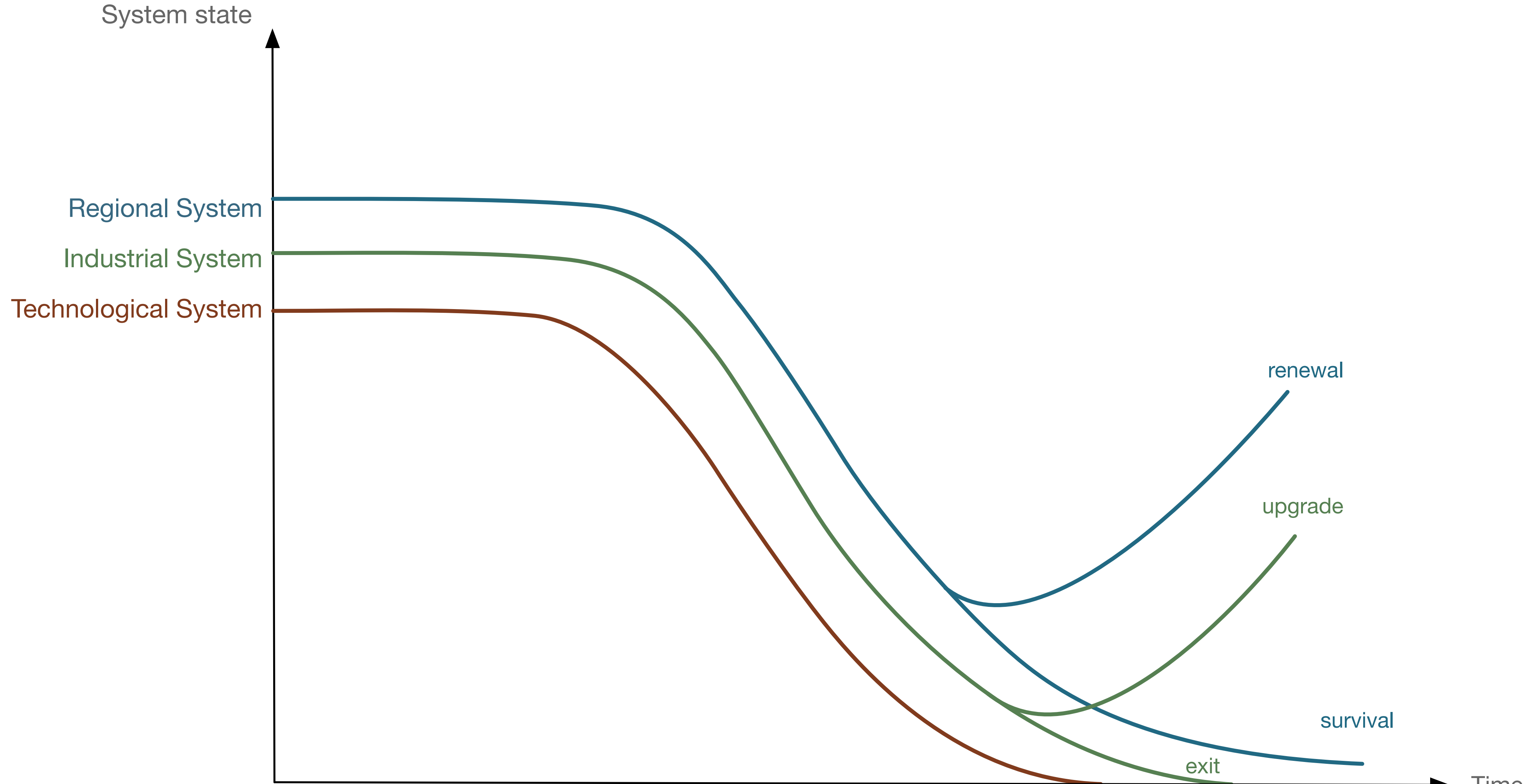
Source: E3G Analysis of Global Energy Monitor Global Coal Plant Tracker data, as of July 2021.

# 1) Phases of decline

# 1) Phases of decline



Nacke, Cherp, Jewell. Phases of fossil fuel decline: Diagnostic framework for policy sequencing and feasible transition pathways in resource dependent regions. Oxford Open Energy. (Forthcoming).

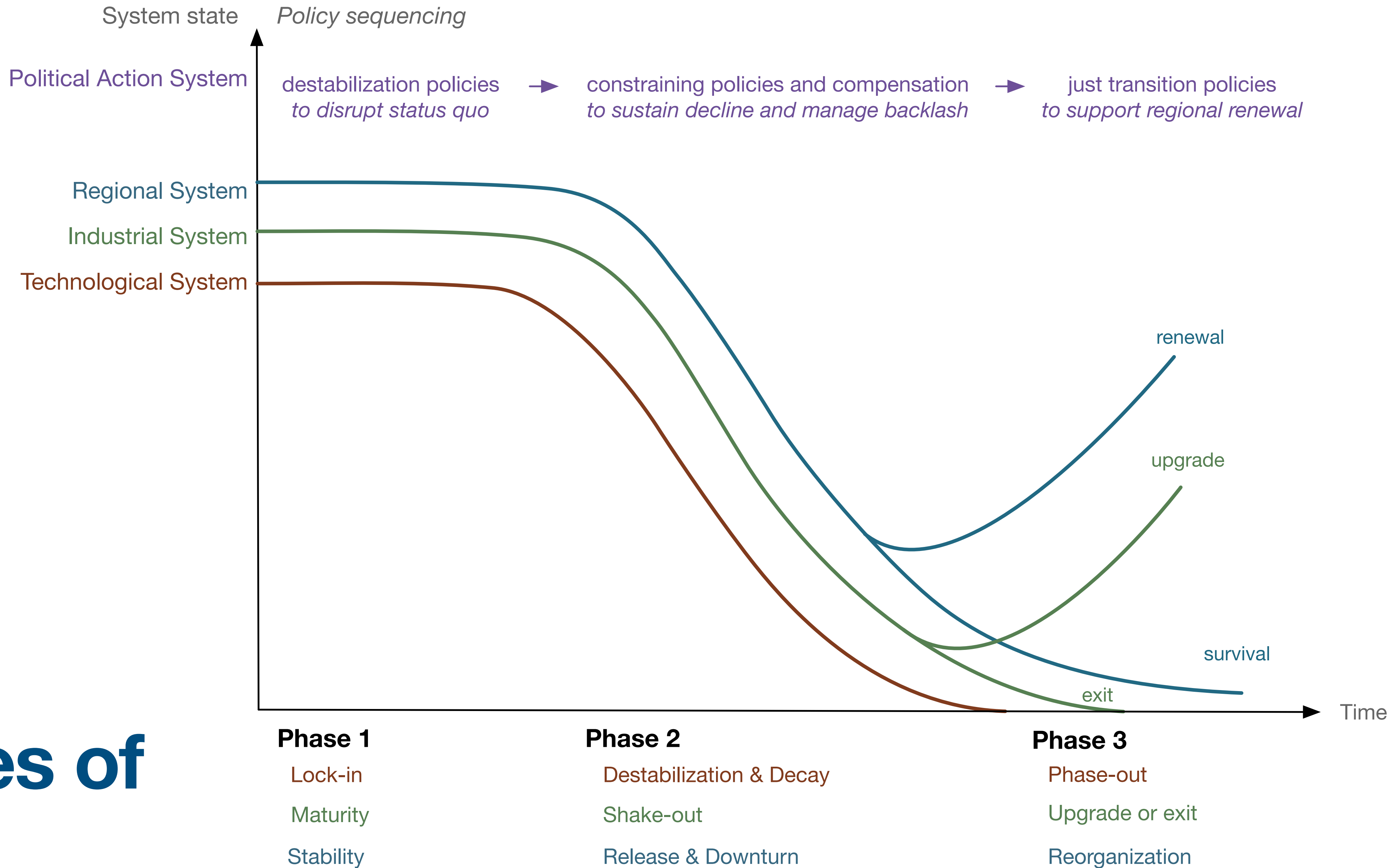


# 1) Phases of decline

Phase 1	Phase 2	Phase 3
Lock-in	Destabilization & Decay	Phase-out
Maturity	Shake-out	Upgrade or exit
Stability	Release & Downturn	Reorganization

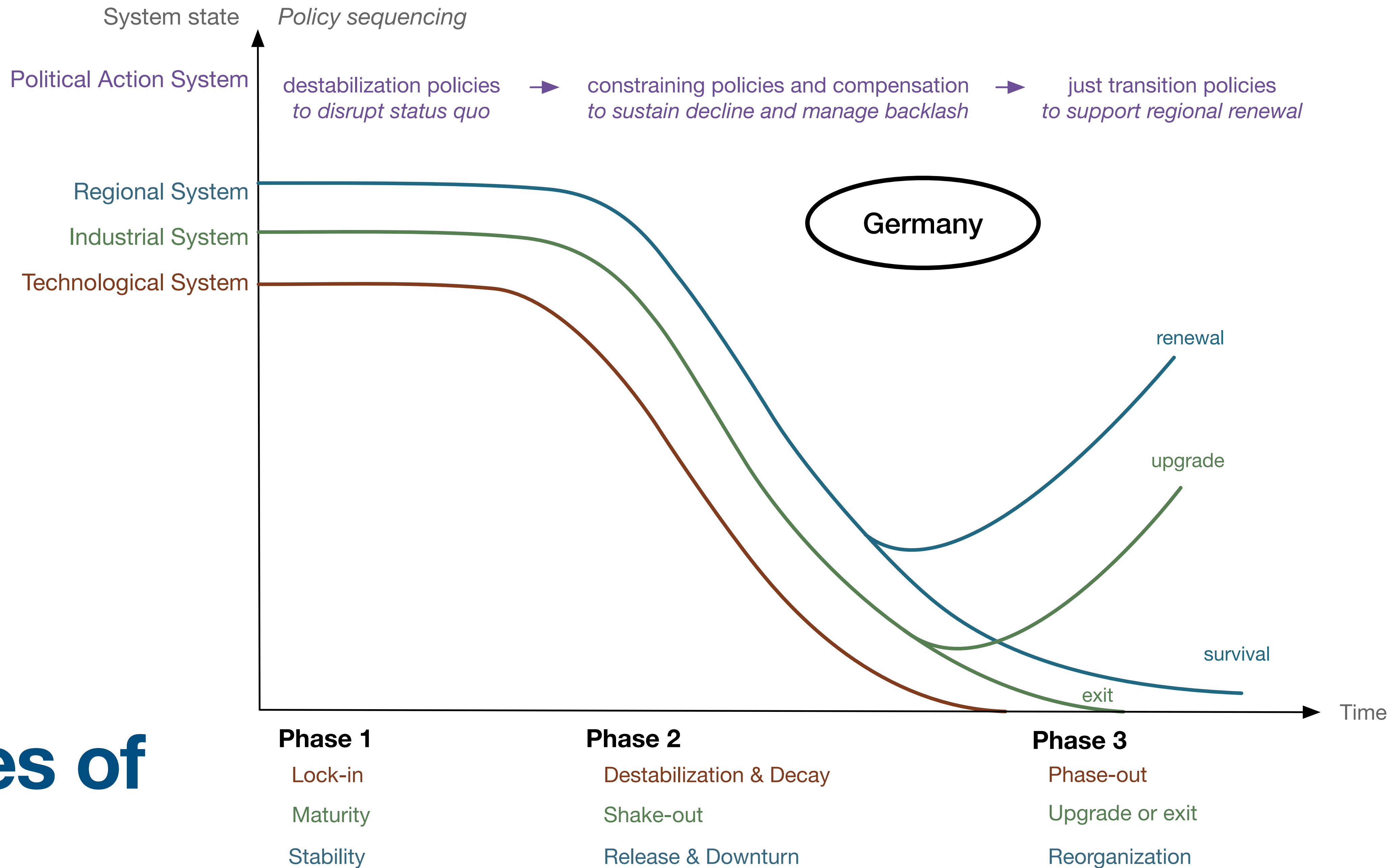
Nacke, Cherp, Jewell. Phases of fossil fuel decline: Diagnostic framework for policy sequencing and feasible transition pathways in resource dependent regions. Oxford Open Energy. (Forthcoming).

# 1) Phases of decline

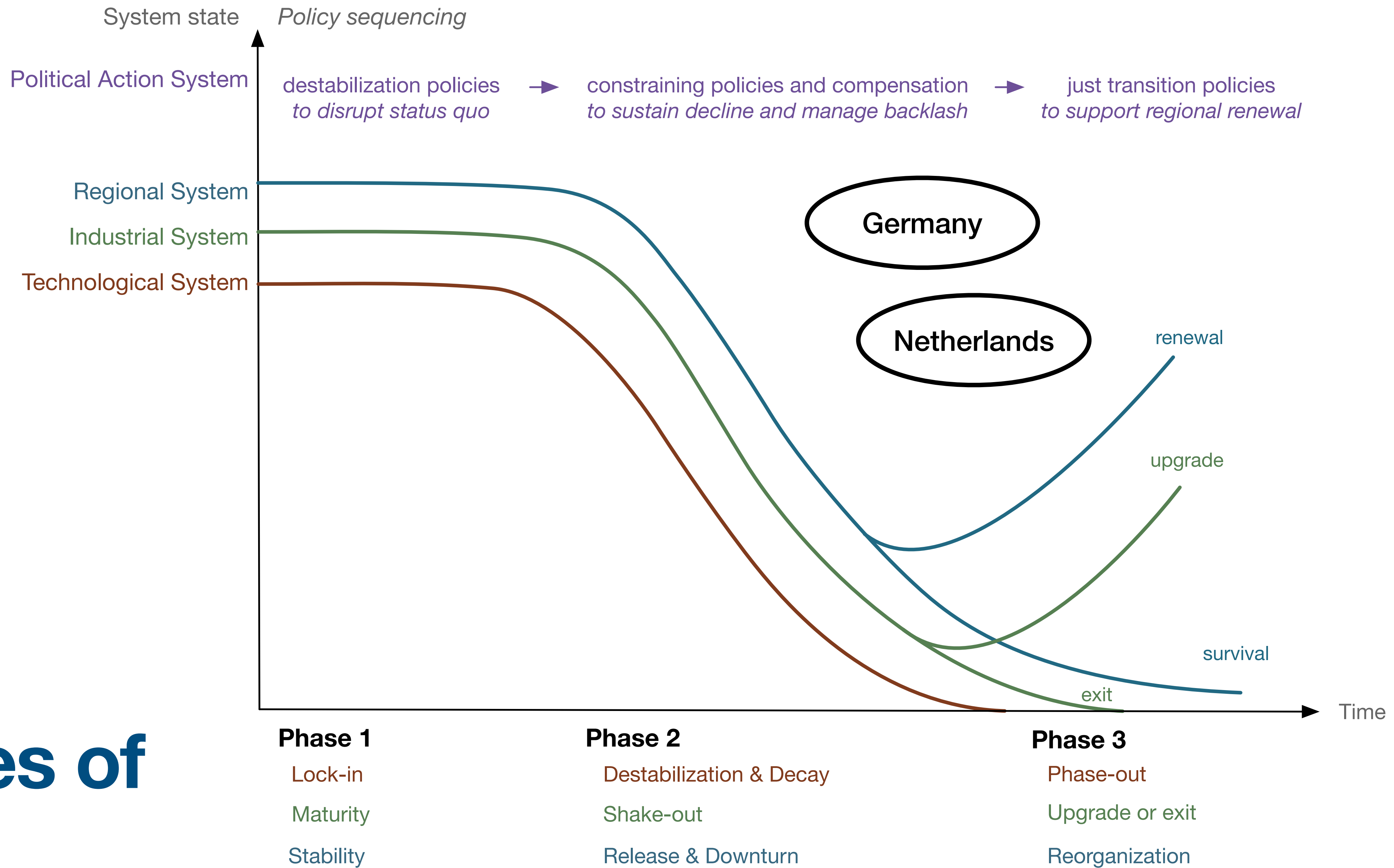




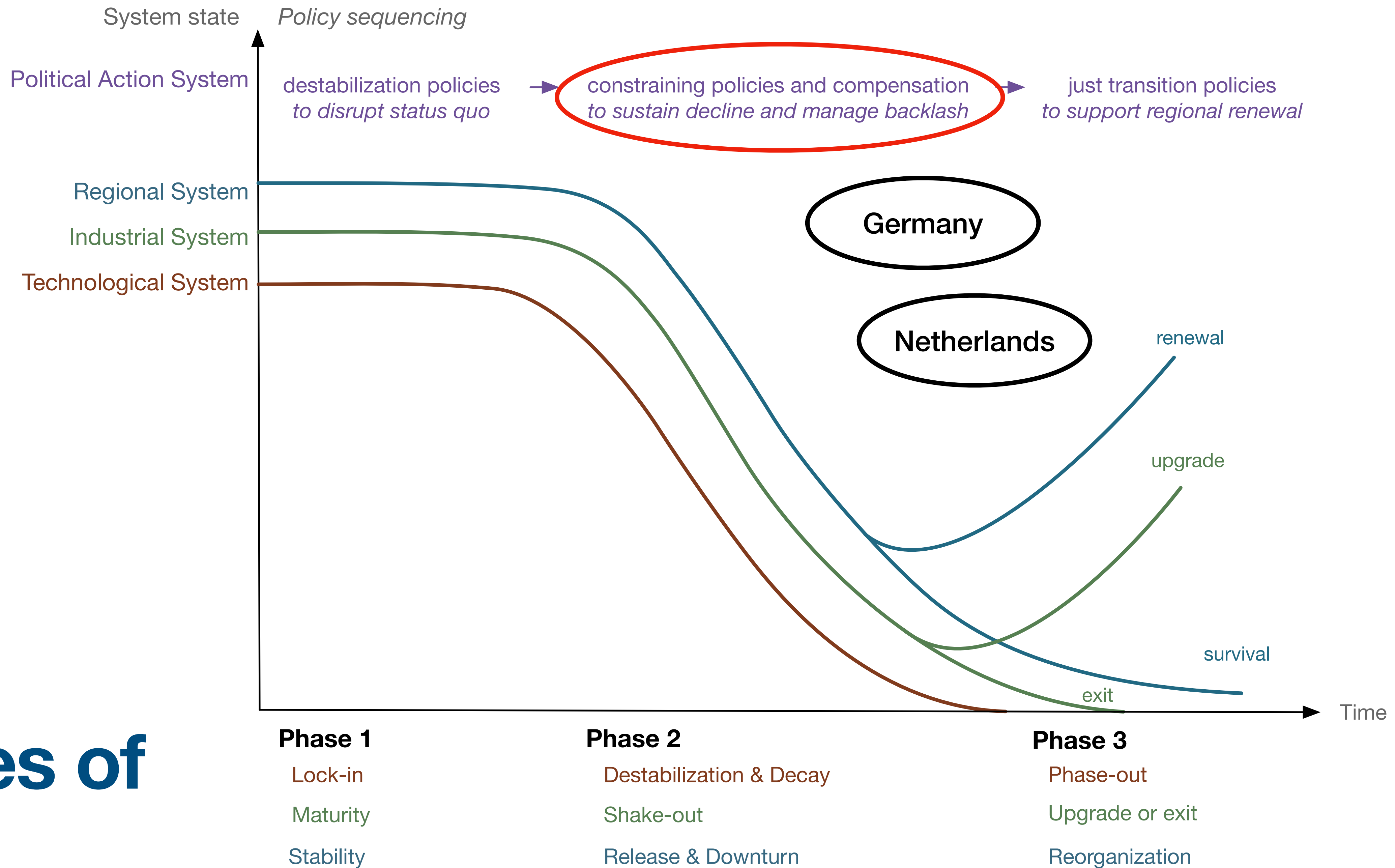
# 1) Phases of decline



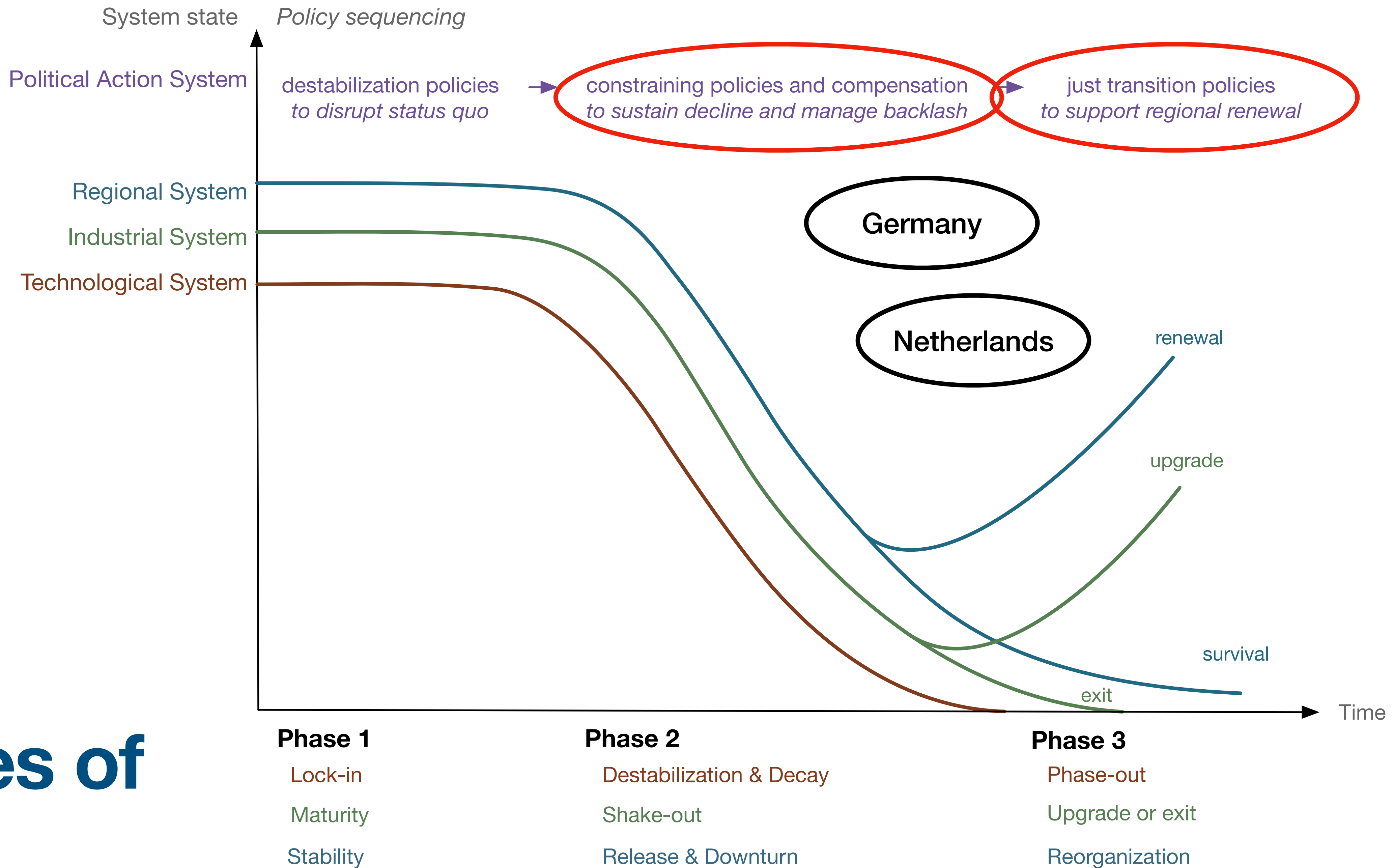
# 1) Phases of decline



# 1) Phases of decline



# 1) Phases of decline



## **2) Costs of phase-out**

# 2) Costs of phase-out

... in European countries

- Germany
- Finland
- Spain
- Romania
- Netherlands
- Czech Republic
- Greece
- Slovakia
- Poland
- Ukraine
- Slovenia
- France

## 2) Costs of phase-out

### ... in European countries

- Germany
- Finland
- Spain
- Romania
- Netherlands
- Czech Republic
- Greece
- Slovakia
- Poland
- Ukraine
- Slovenia
- France

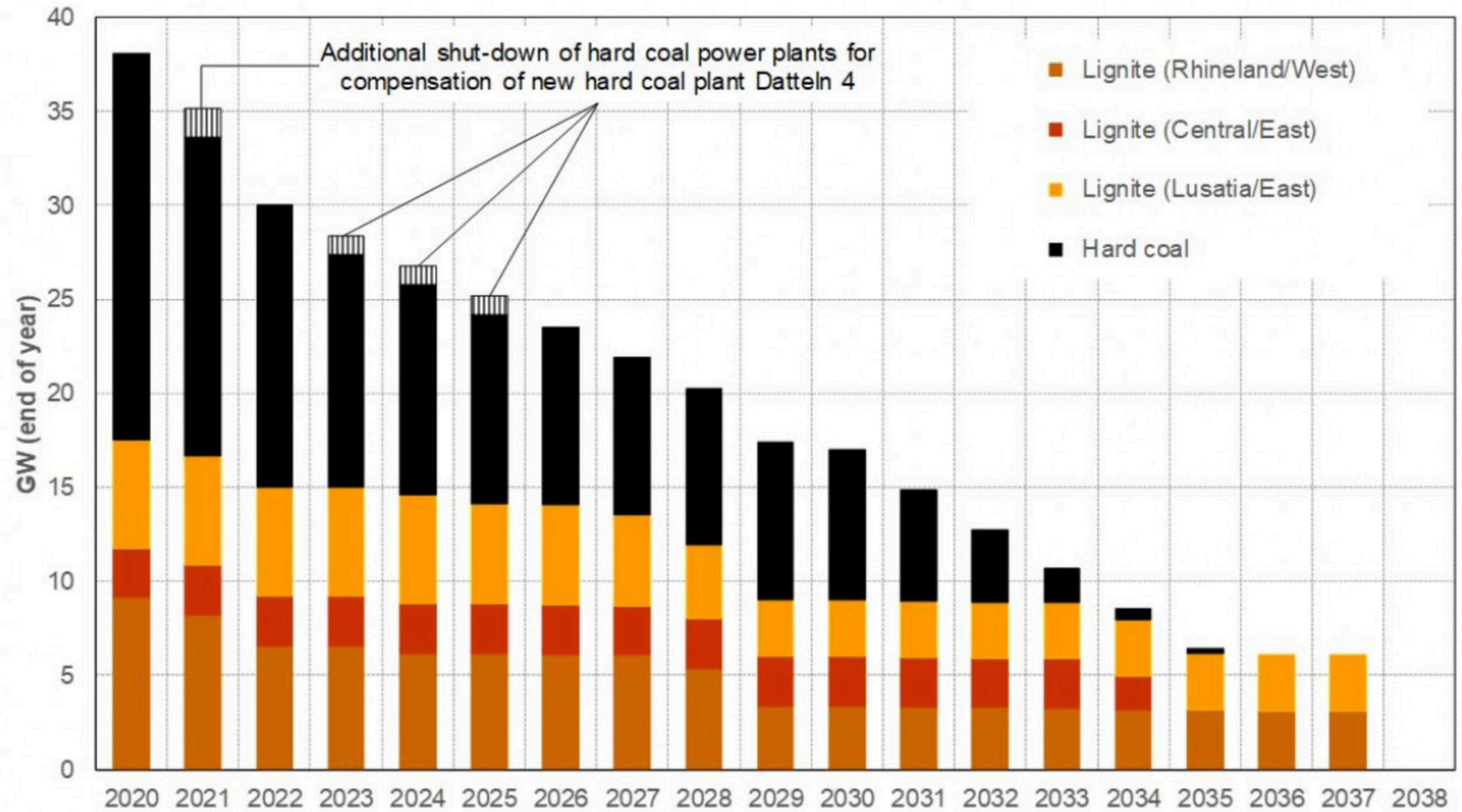
### ... and plan to extend to non-European countries

- Canada
- Chile
- South Korea

**Germany**

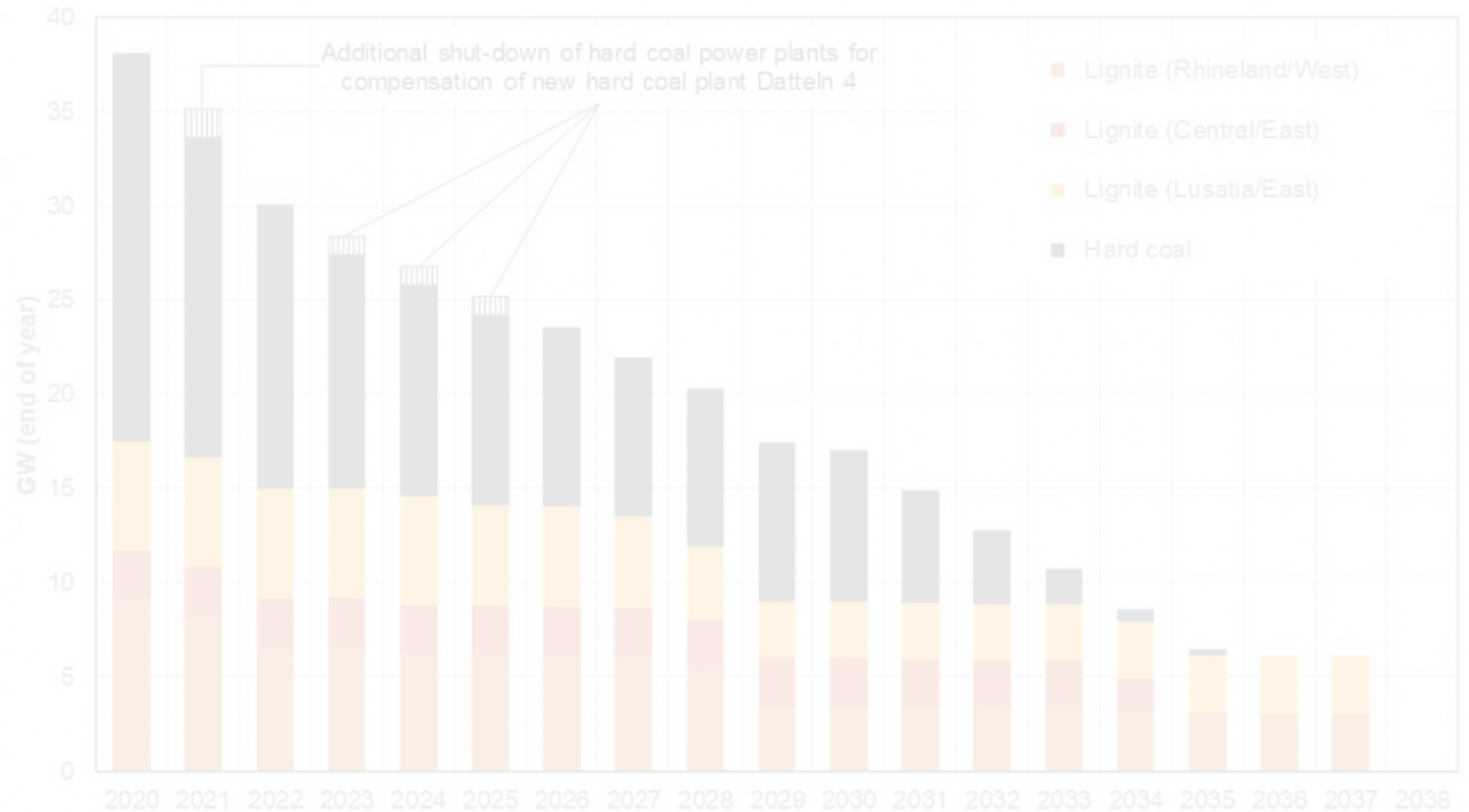


## Coal phase-out in Germany. Capacity reduction path following the decision of the federal cabinet on 29 January 2020 on the draft coal exit law (KVBG)



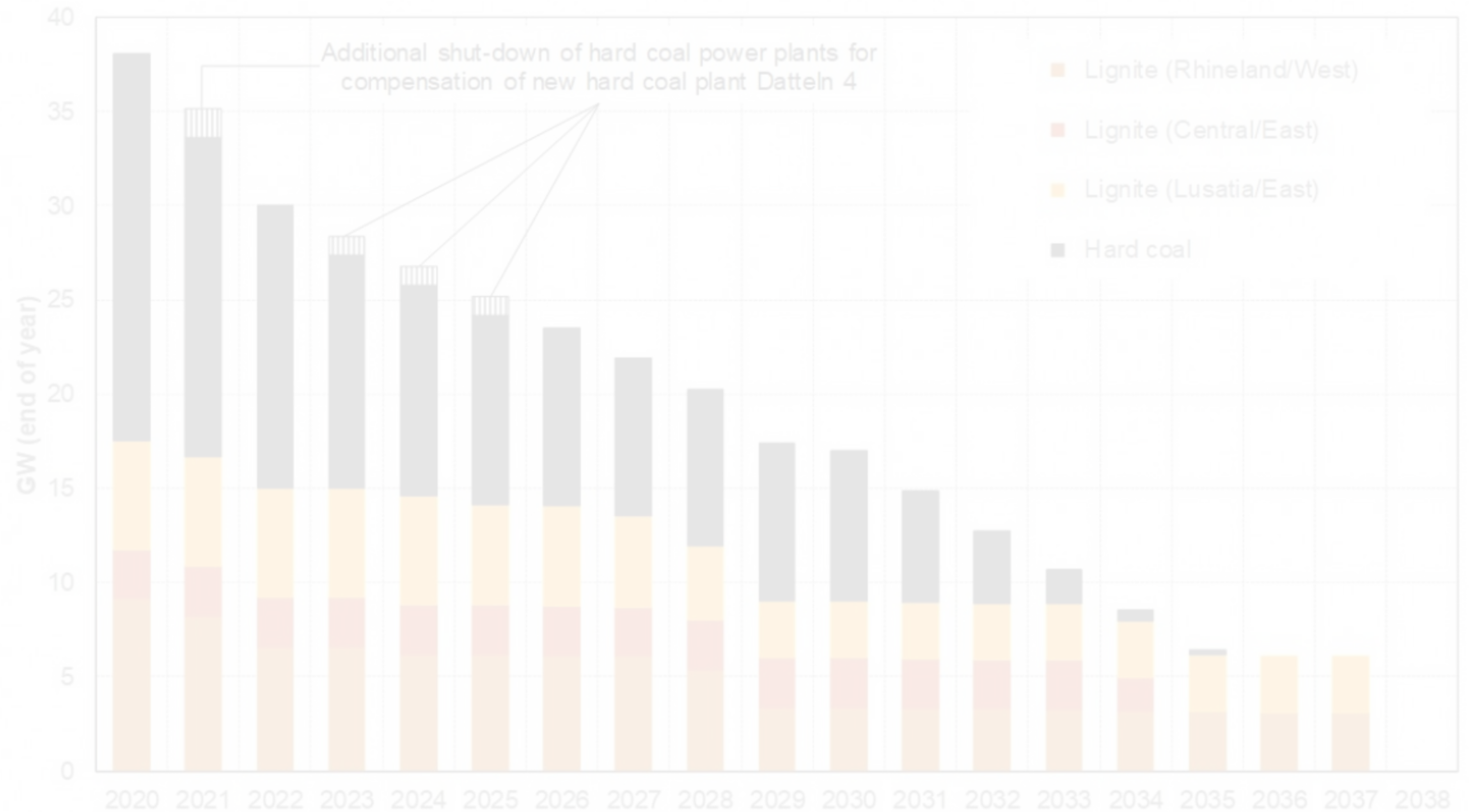
# Germany

Coal phase-out in Germany.  
Capacity reduction path following the decision of the federal cabinet on 29 January 2020  
on the draft coal exit law (KVBG)



# Germany

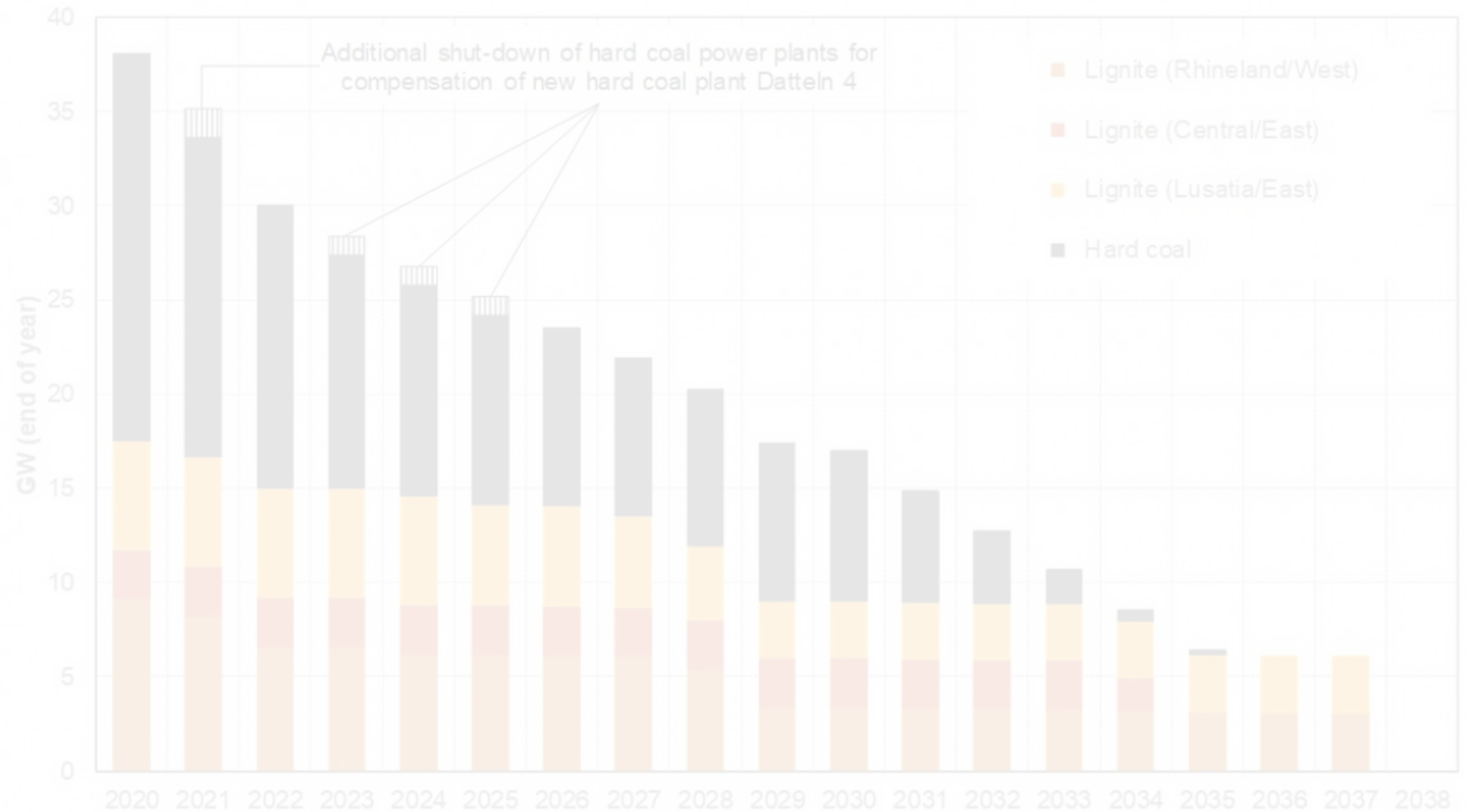
Coal phase-out in Germany.  
Capacity reduction path following the decision of the federal cabinet on 29 January 2020  
on the draft coal exit law (KVBG)



Hard coal plants  
(tender scheme)

# Germany

Coal phase-out in Germany.  
Capacity reduction path following the decision of the federal cabinet on 29 January 2020  
on the draft coal exit law (KVBG)



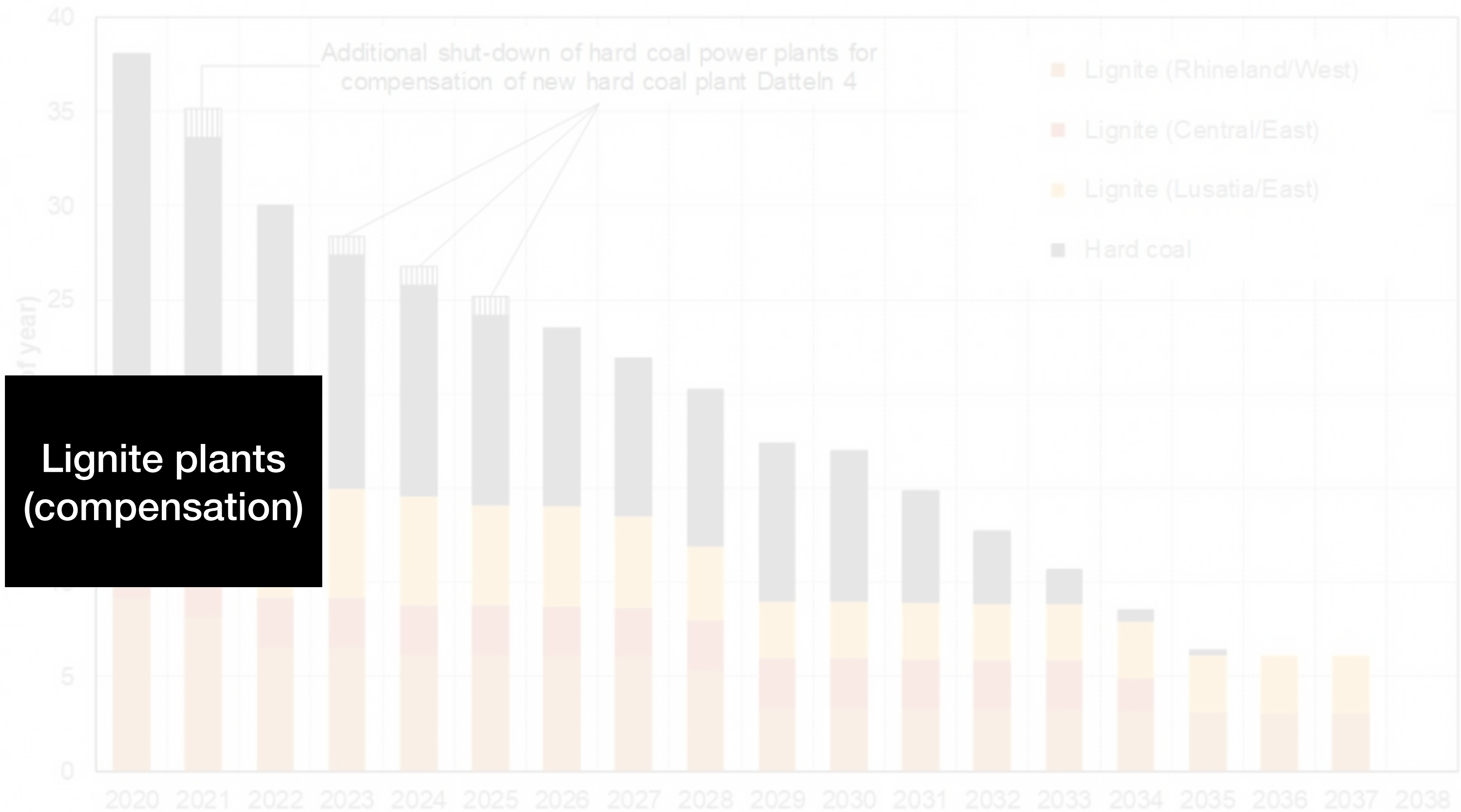
Hard coal plants  
(tender scheme)

Lower  
estimate

2 EUR bn  
(2020)

# Germany

Coal phase-out in Germany.  
Capacity reduction path following the decision of the federal cabinet on 29 January 2020  
on the draft coal exit law (KVBG)



Hard coal plants  
(tender scheme)

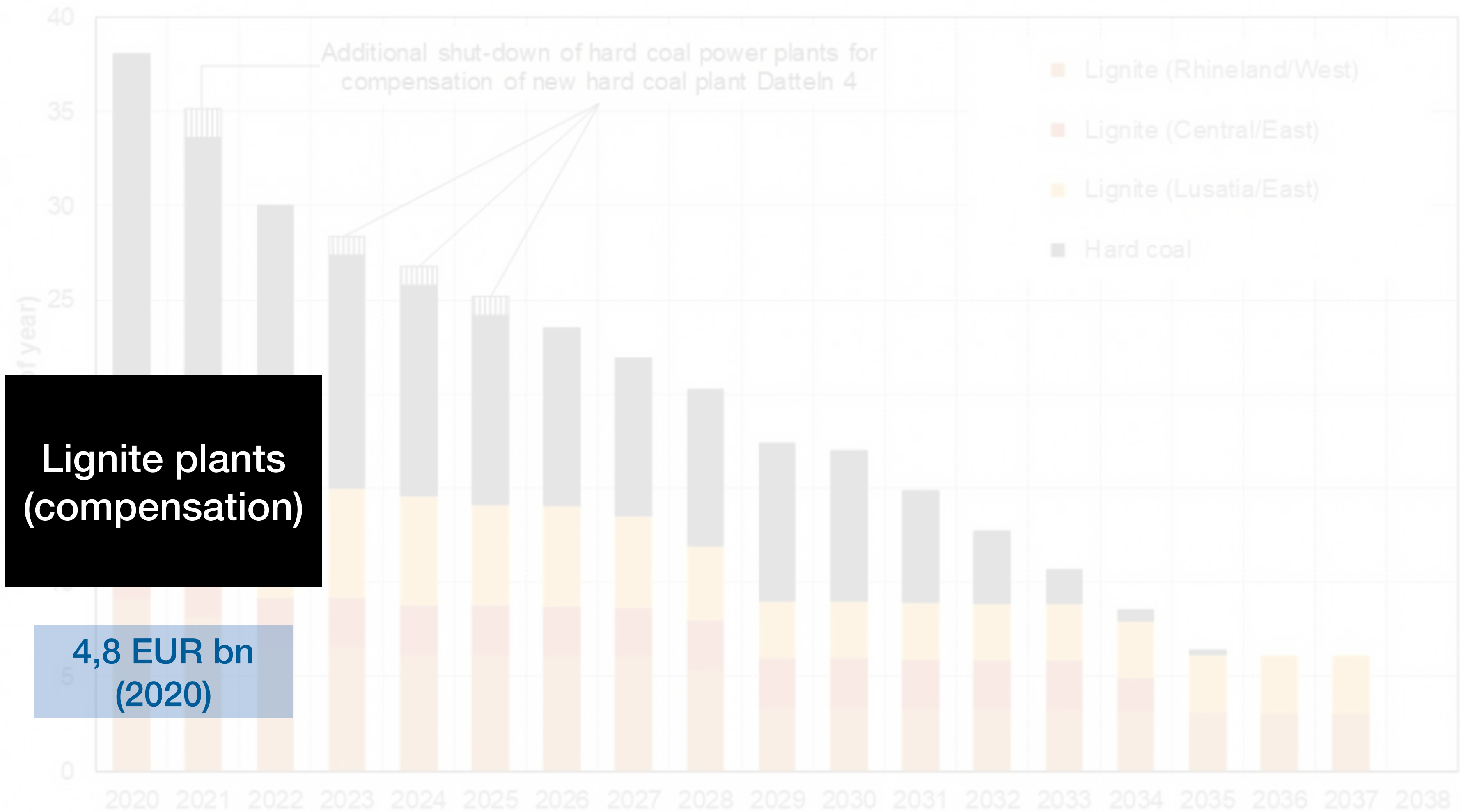
Lignite plants  
(compensation)

Lower  
estimate

2 EUR bn  
(2020)

# Germany

Coal phase-out in Germany.  
Capacity reduction path following the decision of the federal cabinet on 29 January 2020  
on the draft coal exit law (KVBG)



Hard coal plants  
(tender scheme)

Lignite plants  
(compensation)

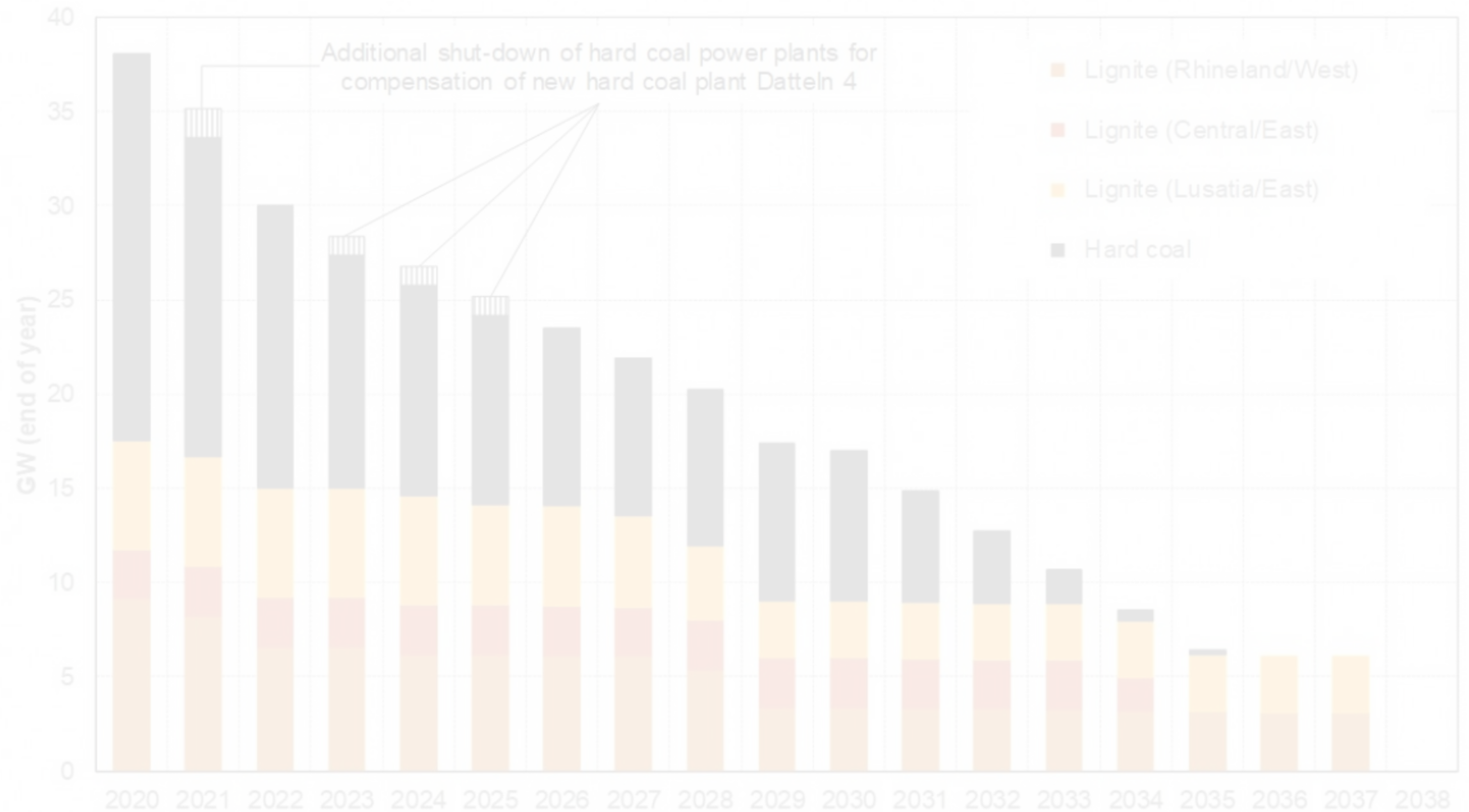
Lower  
estimate

2 EUR bn  
(2020)

4,8 EUR bn  
(2020)

# Germany

Coal phase-out in Germany.  
Capacity reduction path following the decision of the federal cabinet on 29 January 2020  
on the draft coal exit law (KVBG)



Power plant closure

Lower estimate

6,8 EUR bn (2020)

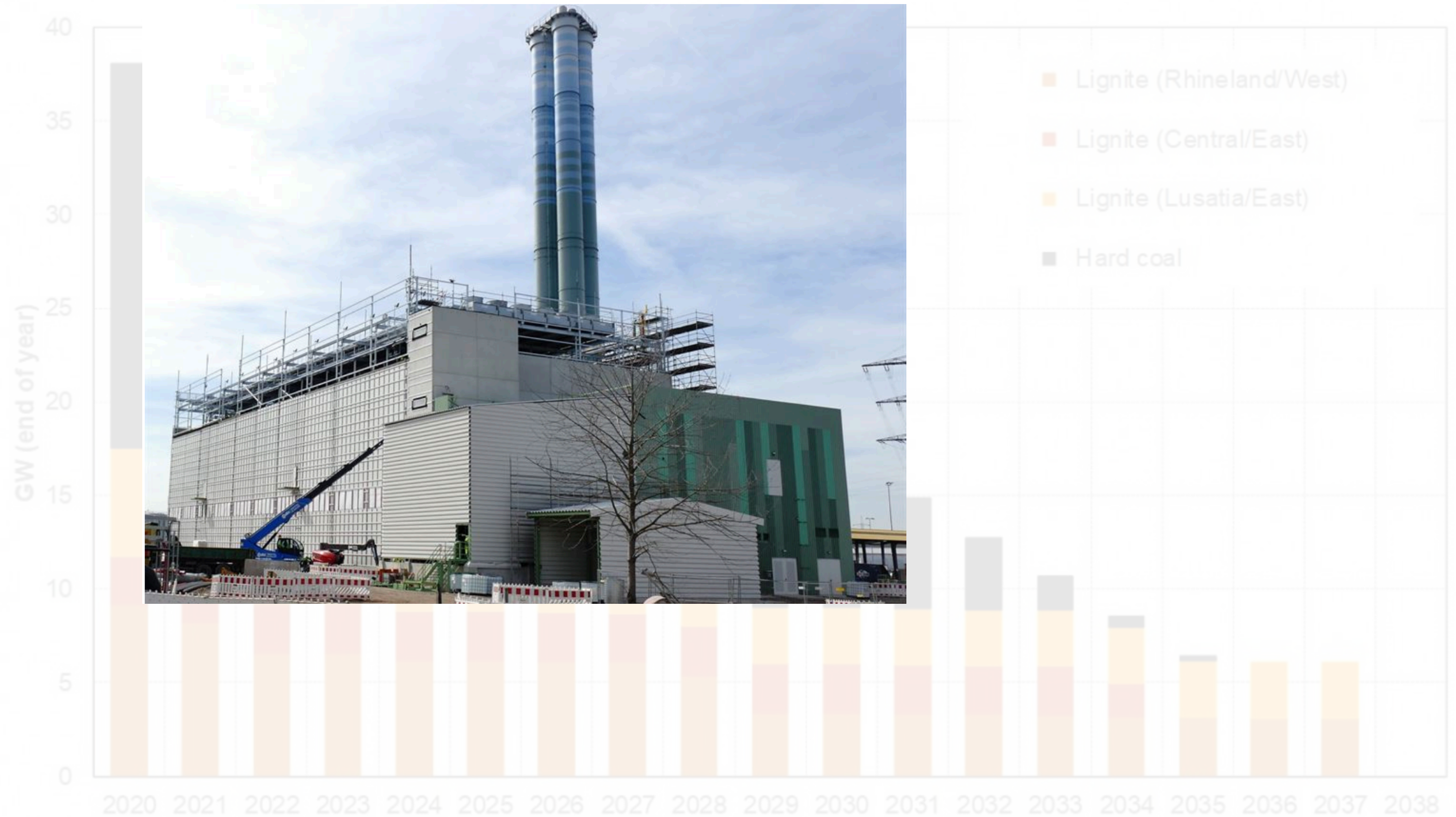
# Germany

Coal phase-out in Germany.  
Capacity reduction path following the decision of the federal cabinet on 29 January 2020  
on the draft coal exit law (KVBG)

Power plant  
closure

Lower  
estimate

6,8 EUR bn  
(2020)





# Germany

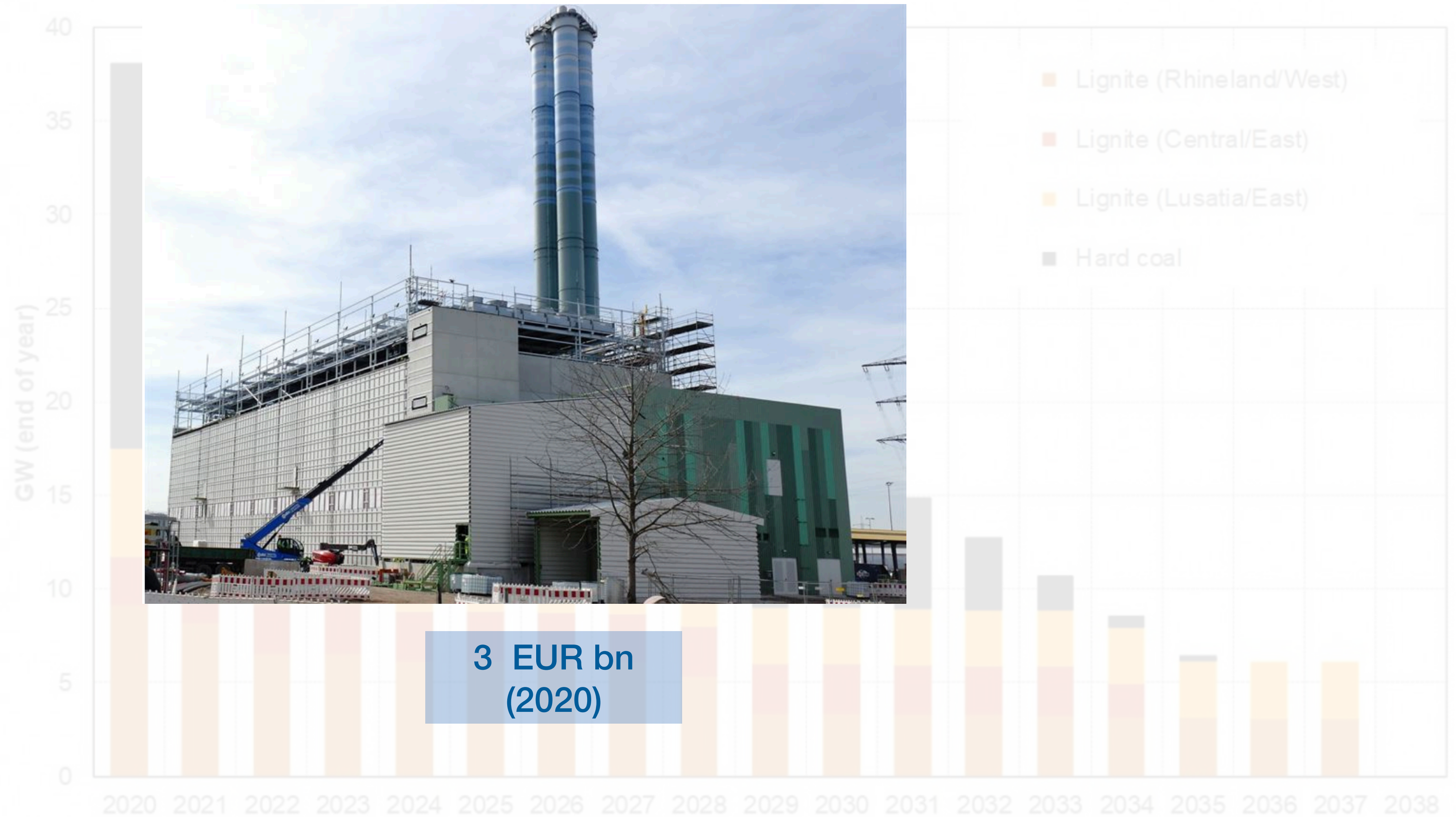
Coal phase-out in Germany.  
Capacity reduction path following the decision of the federal cabinet on 29 January 2020  
on the draft coal exit law (KVBG)

Power plant  
closure

Lower  
estimate

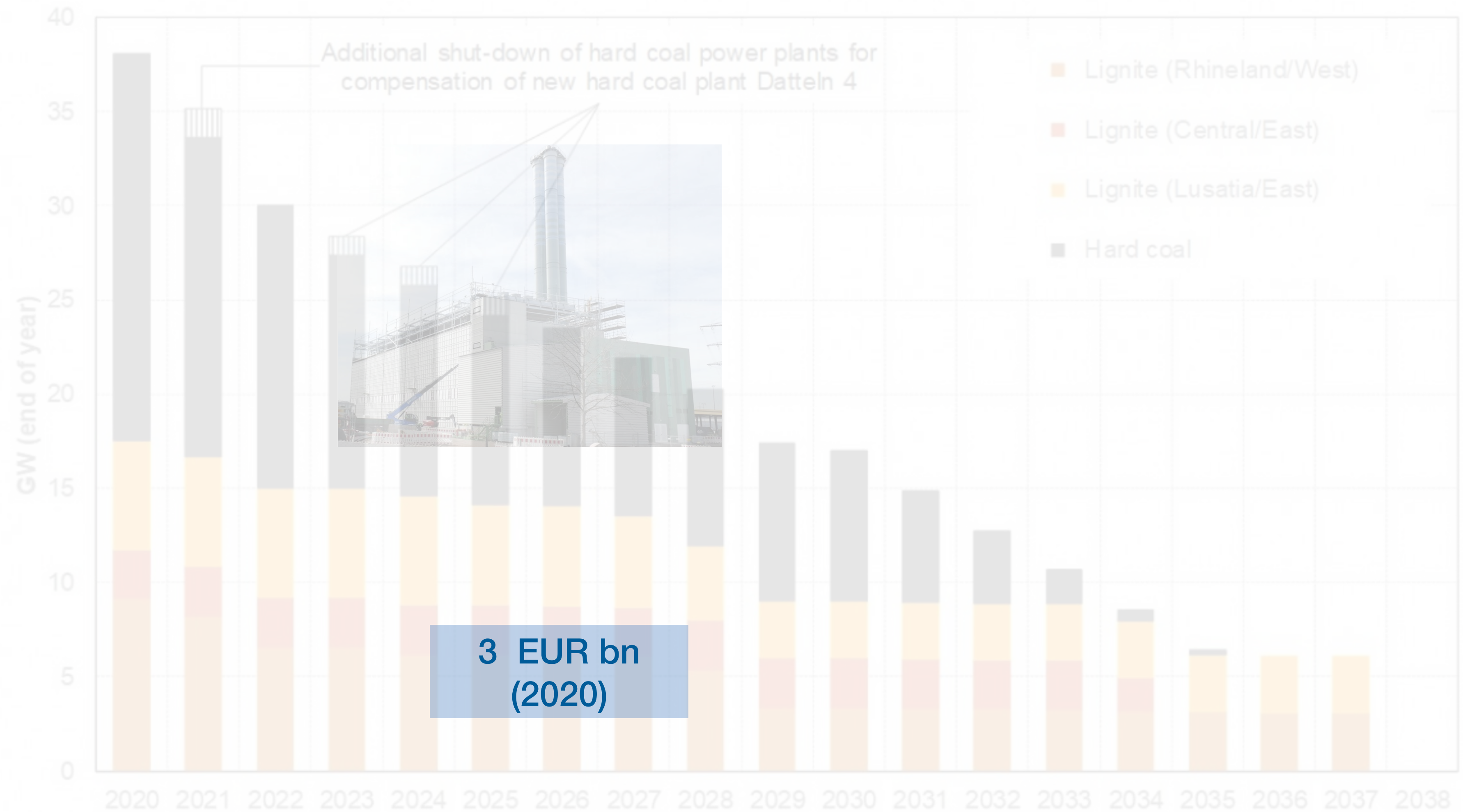
6,8 EUR bn  
(2020)

3 EUR bn  
(2020)



# Germany

Coal phase-out in Germany.  
Capacity reduction path following the decision of the federal cabinet on 29 January 2020  
on the draft coal exit law (KVBG)



Power plant closure

Lower estimate

6,8 EUR bn (2020)

# Germany

Coal phase-out in Germany.  
Capacity reduction path following the decision of the federal cabinet on 29 January 2020  
on the draft coal exit law (KVBG)

Power plant  
closure

Lower  
estimate

6,8 EUR bn  
(2020)

3 EUR bn  
(2020)



# Germany

Coal phase-out in Germany.  
Capacity reduction path following the decision of the federal cabinet on 29 January 2020  
on the draft coal exit law (KVBG)

Power plant  
closure

Lower  
estimate

6,8 EUR bn  
(2020)

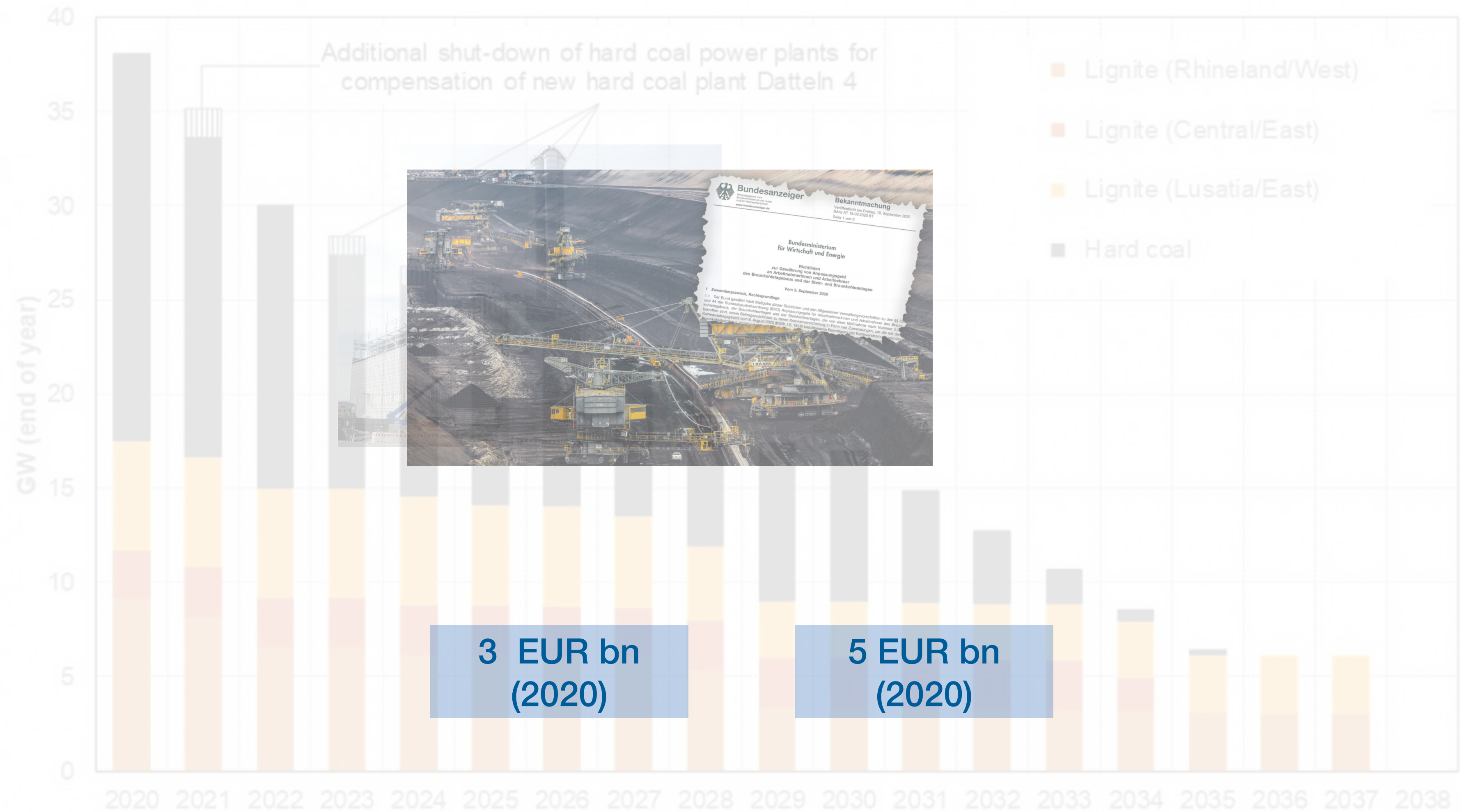
3 EUR bn  
(2020)

5 EUR bn  
(2020)



# Germany

## Coal phase-out in Germany. Capacity reduction path following the decision of the federal cabinet on 29 January 2020 on the draft coal exit law (KVBG)



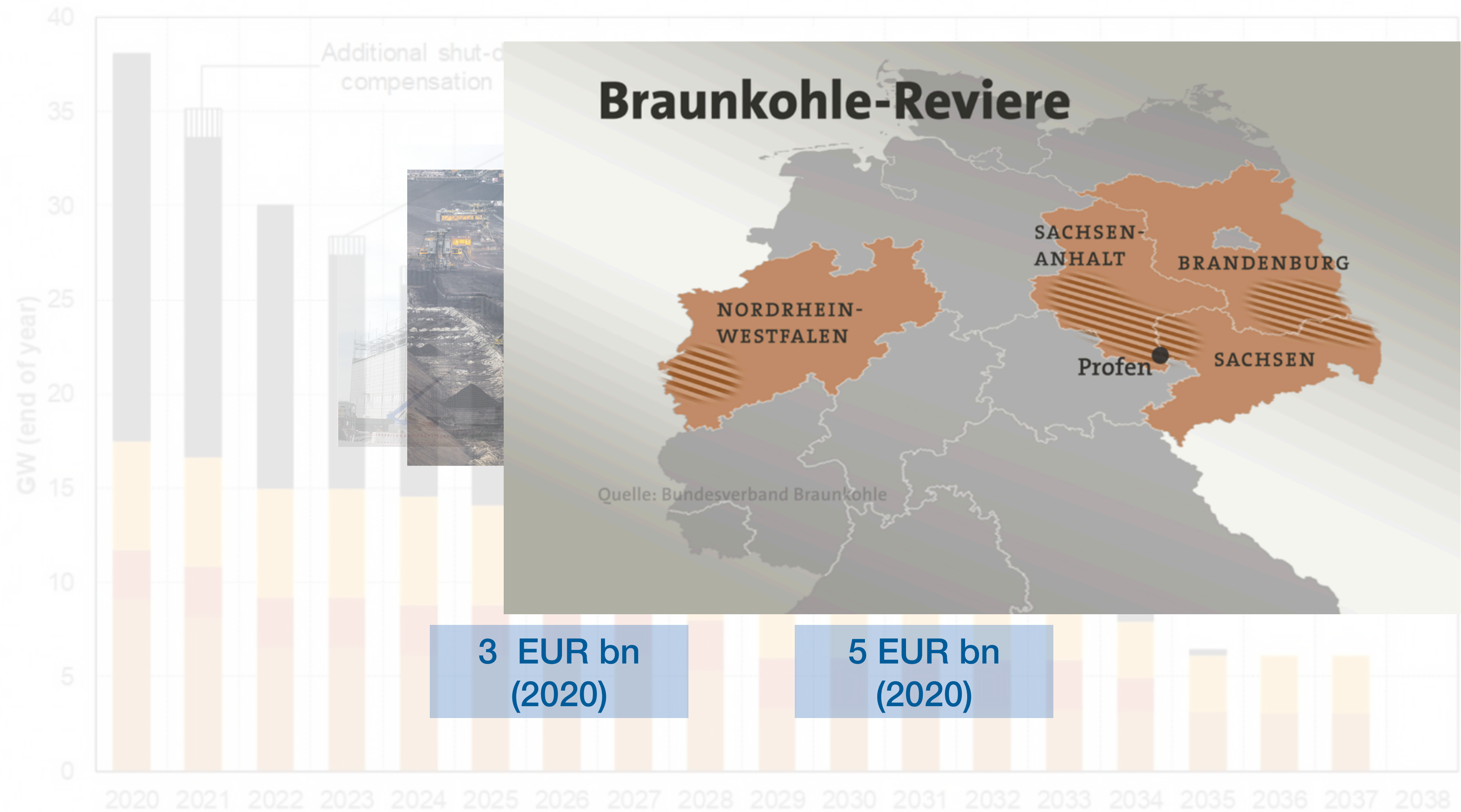
# Germany

Coal phase-out in Germany.  
Capacity reduction path following the decision of the federal cabinet on 29 January 2020  
on the draft coal exit law (KVBG)

Power plant  
closure

Lower  
estimate

6,8 EUR bn  
(2020)



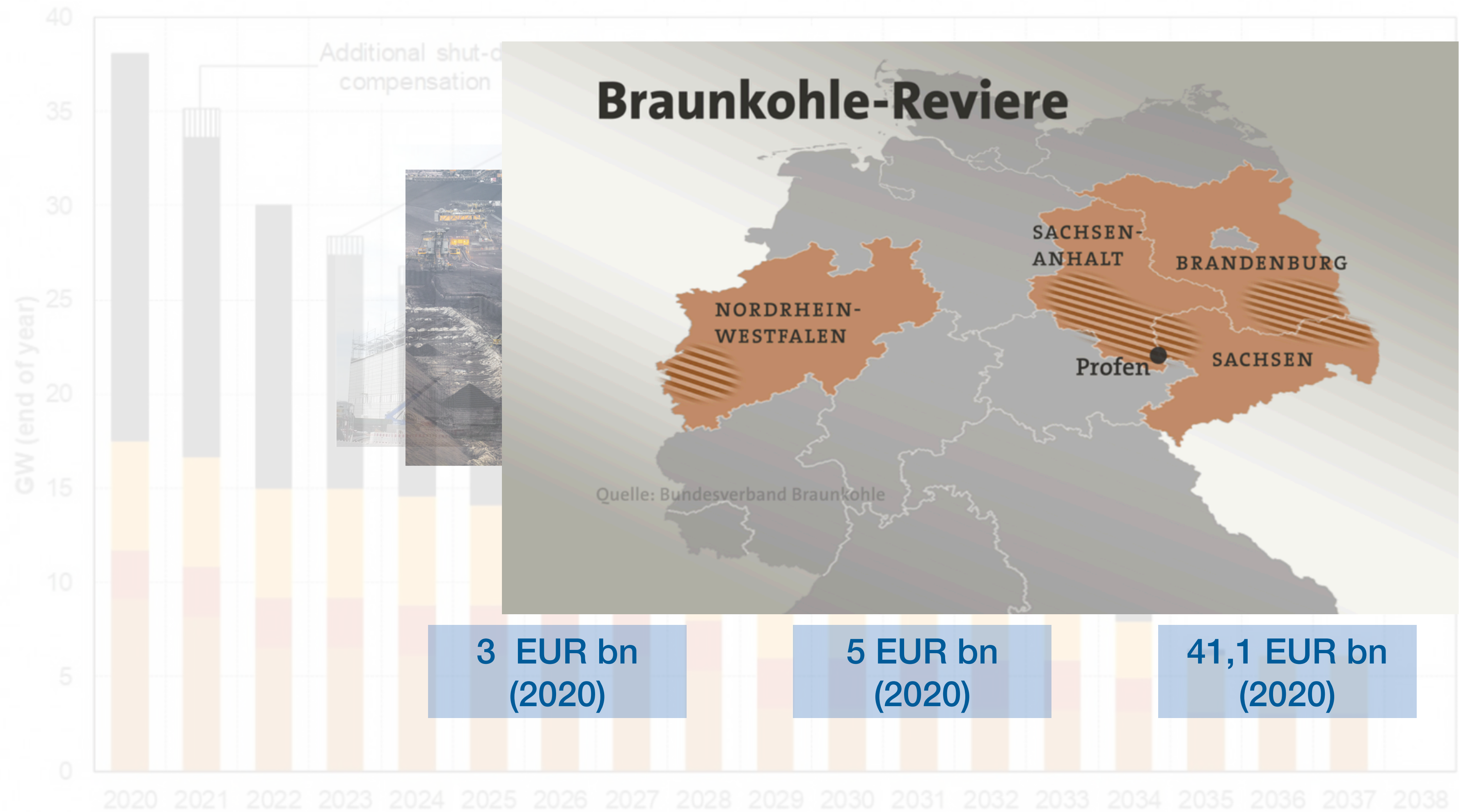
# Germany

Coal phase-out in Germany.  
Capacity reduction path following the decision of the federal cabinet on 29 January 2020  
on the draft coal exit law (KVBG)

Power plant  
closure

Lower  
estimate

6,8 EUR bn  
(2020)



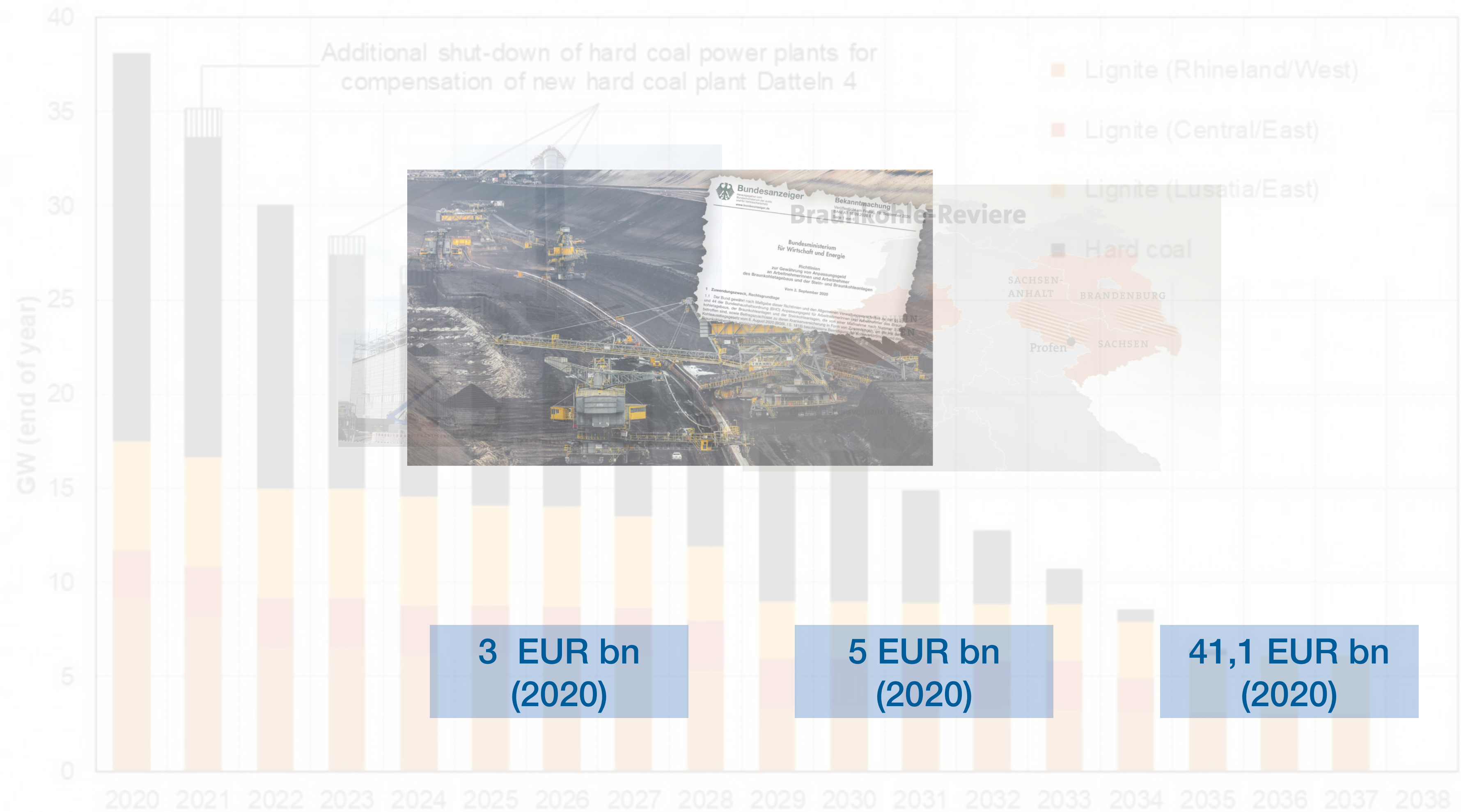
3 EUR bn  
(2020)

5 EUR bn  
(2020)

41,1 EUR bn  
(2020)

# Germany

Coal phase-out in Germany.  
Capacity reduction path following the decision of the federal cabinet on 29 January 2020  
on the draft coal exit law (KVBG)



**Power plant closure**

**Lower estimate**

**6,8 EUR bn (2020)**

**3 EUR bn (2020)**

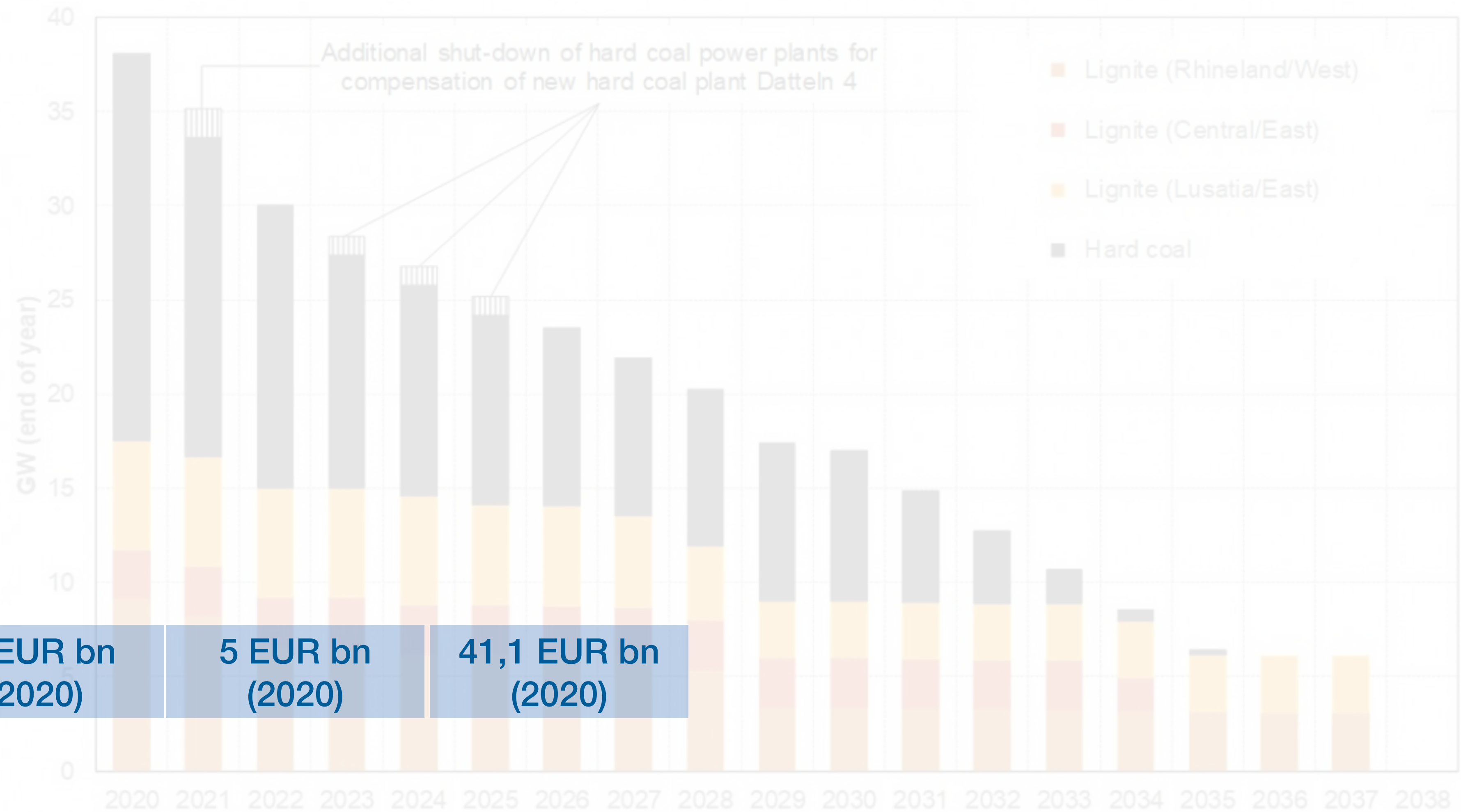
**5 EUR bn (2020)**

**41,1 EUR bn (2020)**



# Germany

Coal phase-out in Germany.  
Capacity reduction path following the decision of the federal cabinet on 29 January 2020  
on the draft coal exit law (KVBG)



Lower estimate

6,8 EUR bn (2020)

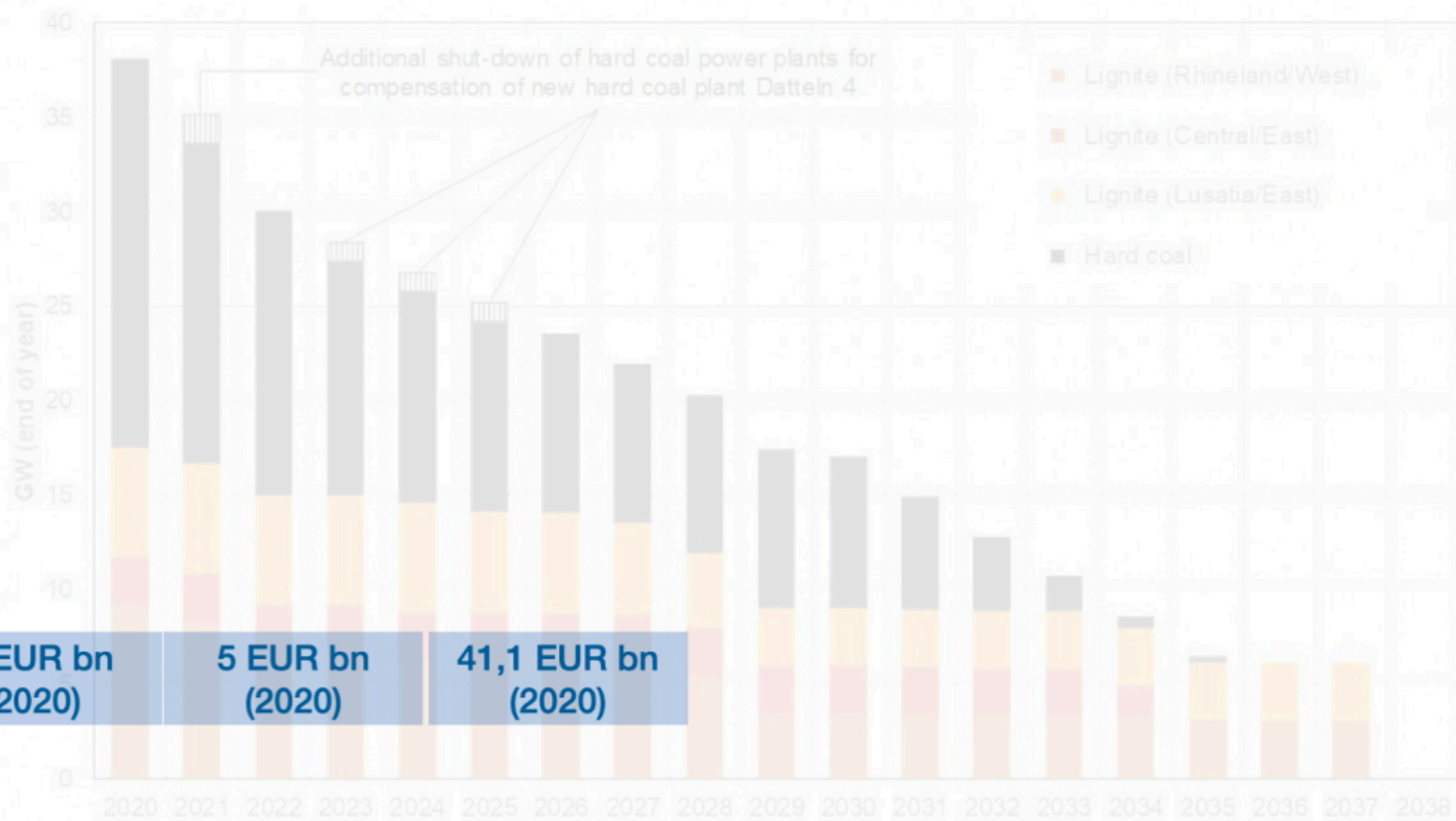
3 EUR bn (2020)

5 EUR bn (2020)

41,1 EUR bn (2020)

# Germany

Coal phase-out in Germany.  
Capacity reduction path following the decision of the federal cabinet on 29 January 2020  
on the draft coal exit law (KVBG)



Lower estimate

6,8 EUR bn (2020)

3 EUR bn (2020)

5 EUR bn (2020)

41,1 EUR bn (2020)

# Germany

Coal phase-out in Germany.

Capacity reduction path following the decision of the federal cabinet on 29 January 2020



Lower estimate

6,8 EUR bn (2020)

3 EUR bn (2020)

5 EUR bn (2020)

41,1 EUR bn (2020)

2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038



# Germany

Coal phase-out in Germany.

Capacity reduction path following the decision of the federal cabinet on 29 January 2020



Lower estimate

6,8 EUR bn (2020)

3 EUR bn (2020)

5 EUR bn (2020)

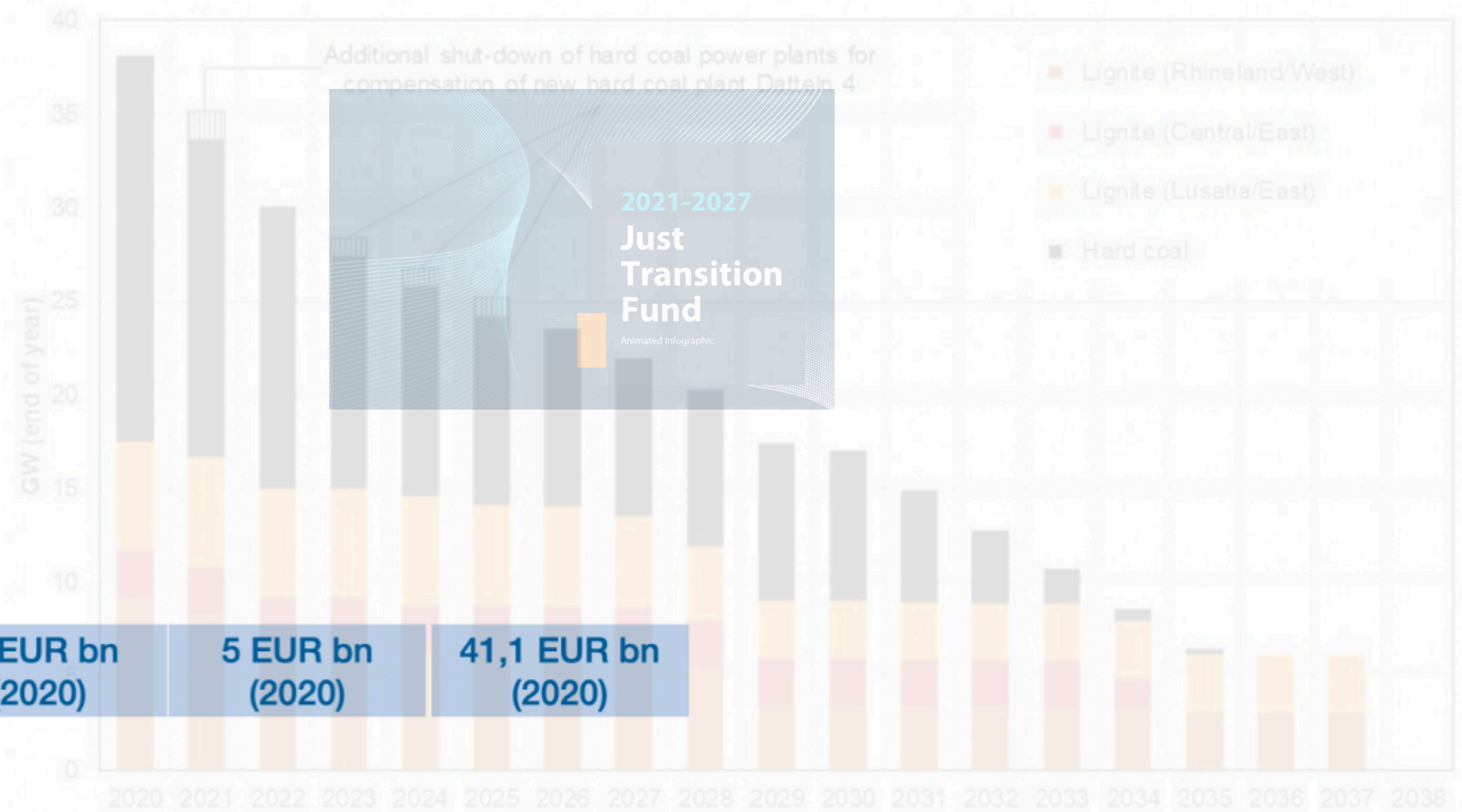
41,1 EUR bn (2020)

Upper estimate

2,3 EUR bn (2020)

# Germany

## Coal phase-out in Germany. Capacity reduction path following the decision of the federal cabinet on 29 January 2020 on the draft coal exit law (KVBG)



Lower estimate

6,8 EUR bn (2020)

3 EUR bn (2020)

5 EUR bn (2020)

41,1 EUR bn (2020)

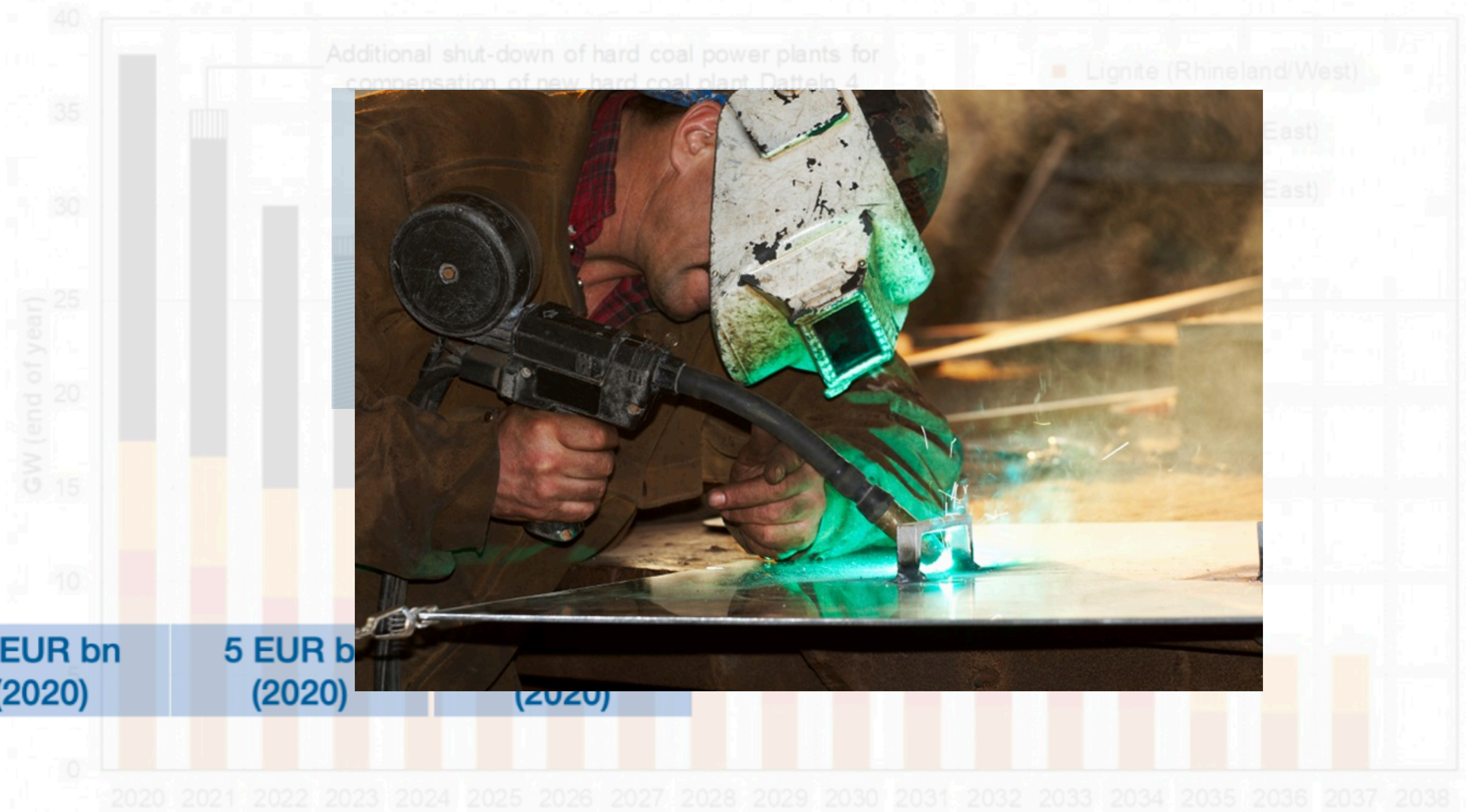
Upper estimate

2,3 EUR bn (2020)

# Germany

Coal phase-out in Germany.

Capacity reduction path following the decision of the federal cabinet on 29 January 2020 on the draft coal exit law (KVBG)



Lower estimate

6,8 EUR bn (2020)

3 EUR bn (2020)

5 EUR bn (2020)

5 EUR bn (2020)

5 EUR bn (2020)

5 EUR bn (2020)

5 EUR bn (2020)

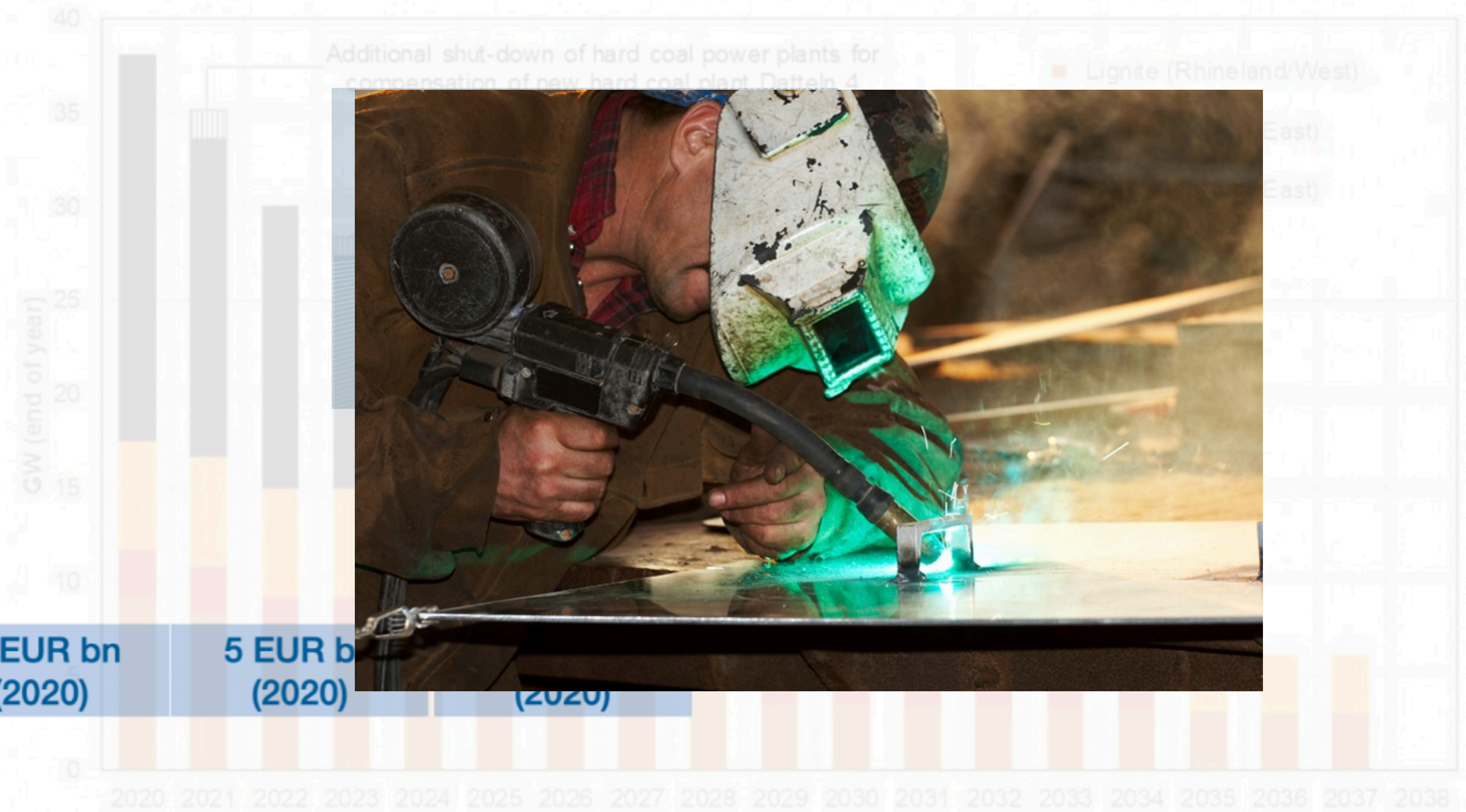
Upper estimate

2,3 EUR bn (2020)

# Germany

Coal phase-out in Germany.

Capacity reduction path following the decision of the federal cabinet on 29 January 2020 on the draft coal exit law (KVBG)



Lower estimate

6,8 EUR bn (2020)

3 EUR bn (2020)

5 EUR bn (2020)

2,3 EUR bn (2020)

30 EUR bn (2020)

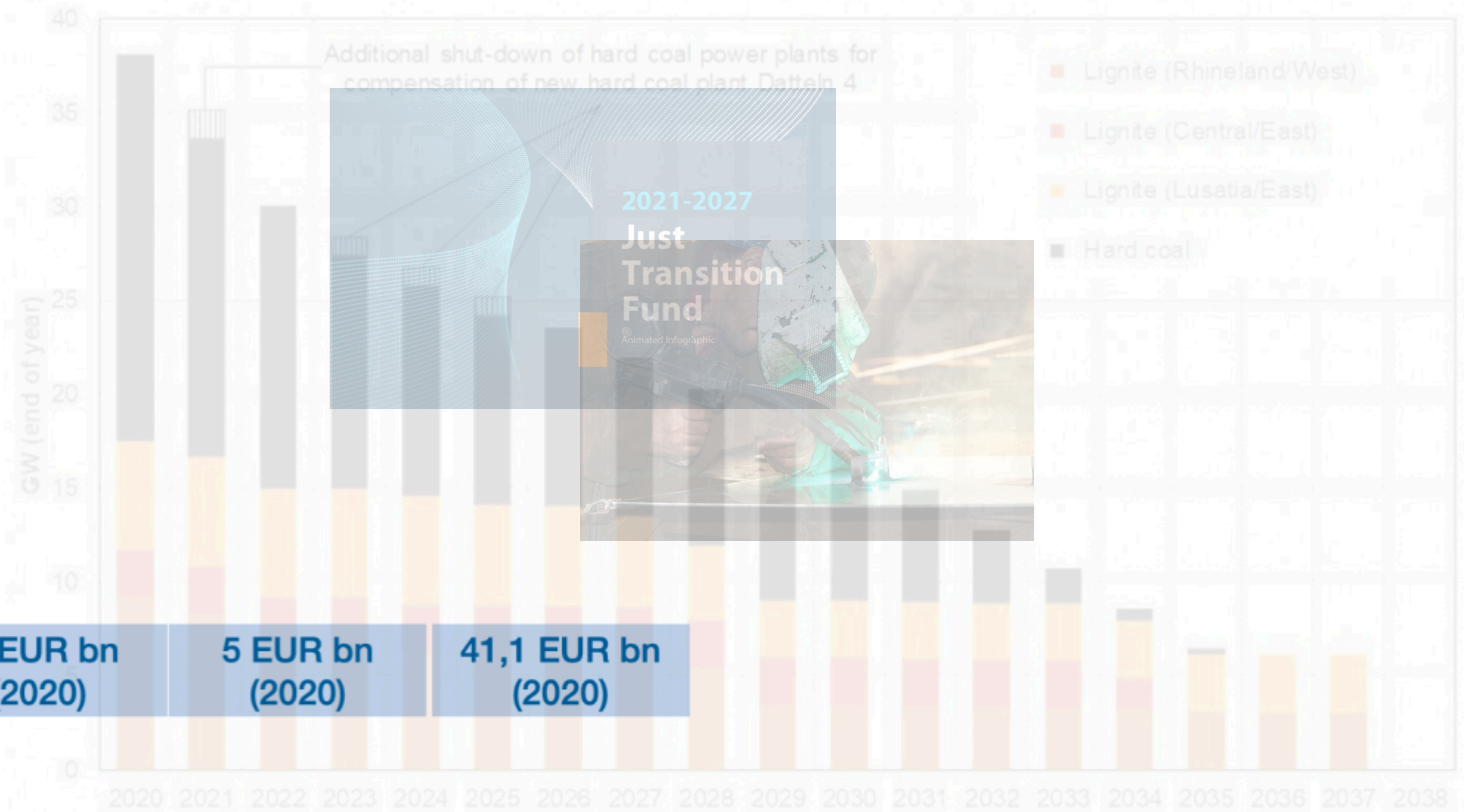
Upper estimate

2,3 EUR bn (2020)

30 EUR bn (2020)

# Germany

Coal phase-out in Germany.  
Capacity reduction path following the decision of the federal cabinet on 29 January 2020  
on the draft coal exit law (KVBG)



Lower estimate

6,8 EUR bn (2020)

3 EUR bn (2020)

5 EUR bn (2020)

41,1 EUR bn (2020)

Upper estimate

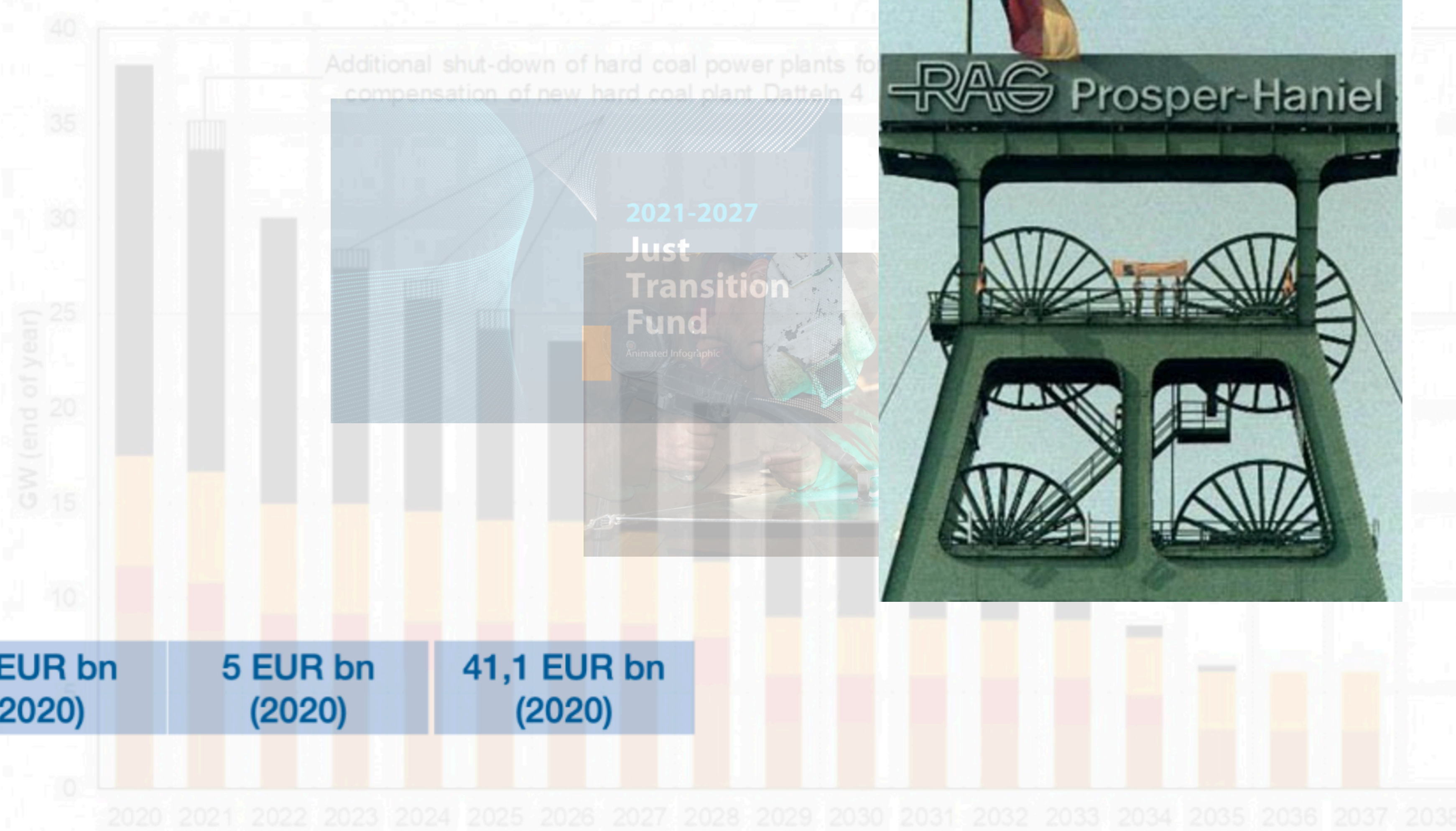
2,3 EUR bn (2020)

30 EUR bn (2020)



# Germany

Coal phase-out in Germany  
Capacity reduction path following the decision of the  
on the draft coal exit law



**Lower  
estimate**

**6,8 EUR bn  
(2020)**

**3 EUR bn  
(2020)**

**5 EUR bn  
(2020)**

**41,1 EUR bn  
(2020)**

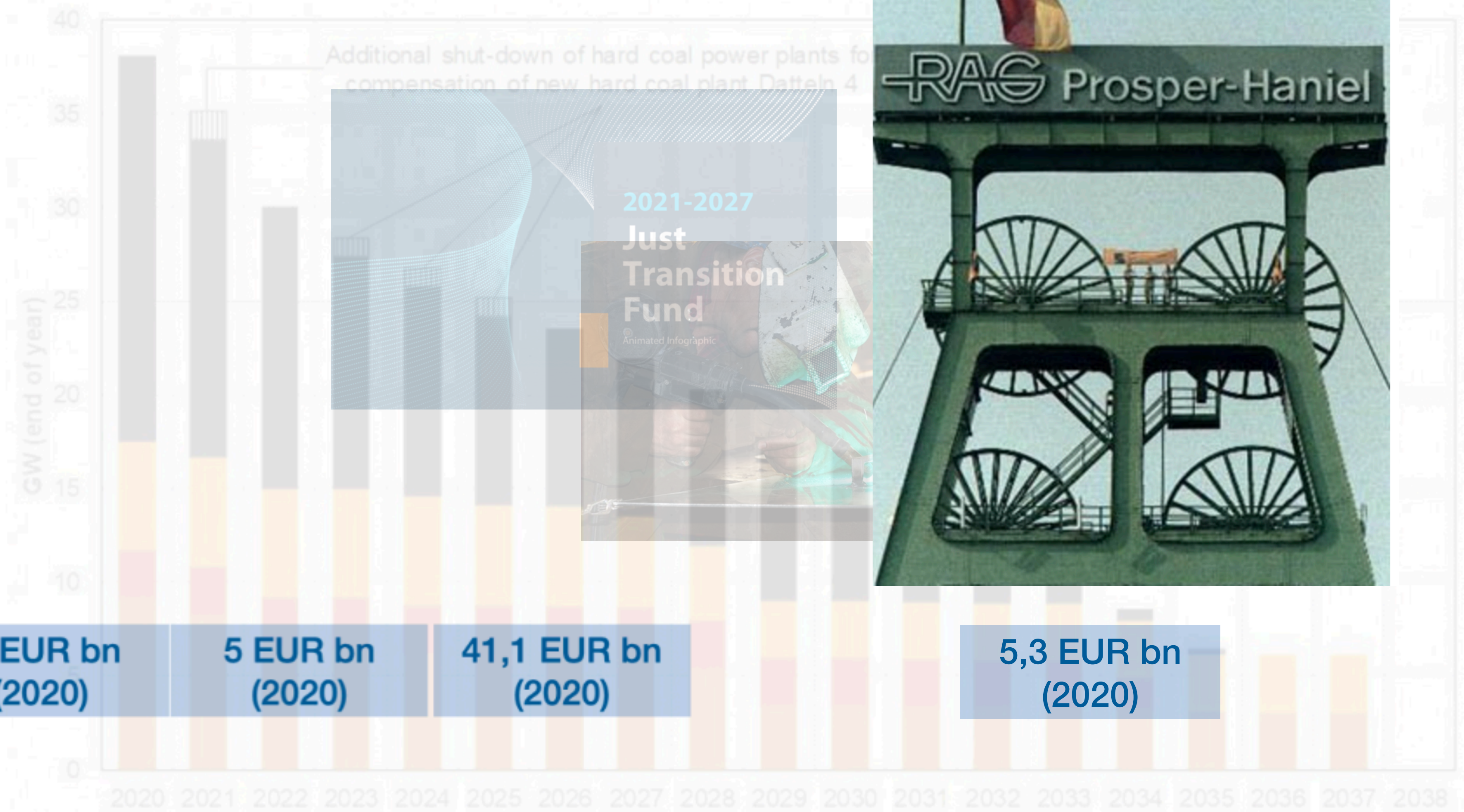
**Upper  
estimate**

**2,3 EUR bn  
(2020)**

**30 EUR bn  
(2020)**

# Germany

Coal phase-out in Germany  
Capacity reduction path following the decision of the  
on the draft coal exit law



Lower  
estimate

6,8 EUR bn  
(2020)

3 EUR bn  
(2020)

5 EUR bn  
(2020)

41,1 EUR bn  
(2020)

5,3 EUR bn  
(2020)

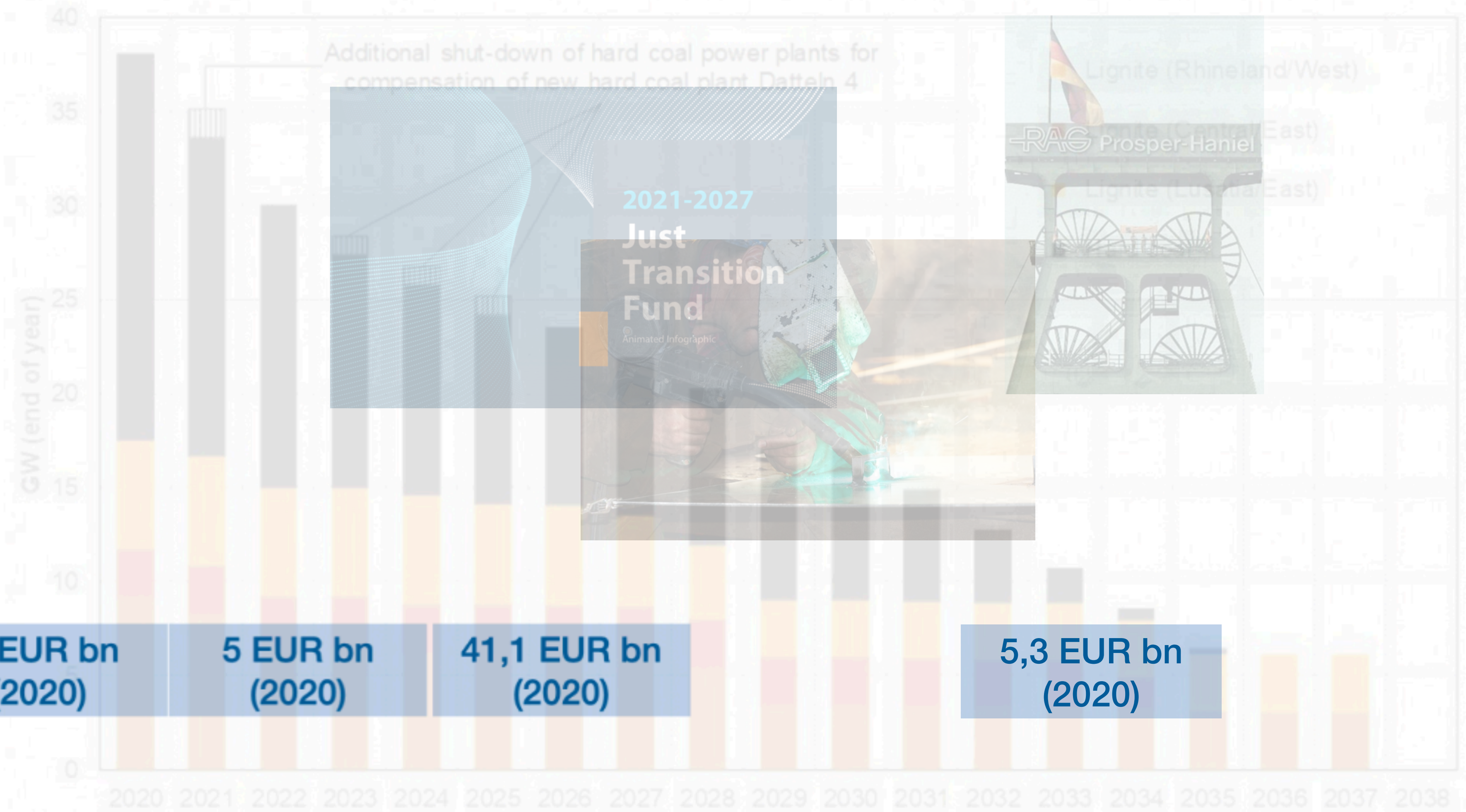
Upper  
estimate

2,3 EUR bn  
(2020)

30 EUR bn  
(2020)

# Germany

Coal phase-out in Germany.  
Capacity reduction path following the decision of the federal cabinet on 29 January 2020  
on the draft coal exit law (KVBG)



Lower estimate

6,8 EUR bn (2020)

3 EUR bn (2020)

5 EUR bn (2020)

41,1 EUR bn (2020)

5,3 EUR bn (2020)

Upper estimate

2,3 EUR bn (2020)

30 EUR bn (2020)

# Netherlands

# Netherlands

Energy-plant	Hemweg-centrale	Amer-centrale	Centrale Rotterdam	Maasvlakte-centrale	Eemshaven-centrale
Company	VATTENFALL 	RWE	ONYX POWER	uni per	RWE
End date coal	December 23 <sup>rd</sup> 2019	December 31 <sup>st</sup> 2024	December 31 <sup>st</sup> 2029	December 31 <sup>st</sup> 2029	December 31 <sup>st</sup> 2029

# Netherlands

Energy-plant	Hemweg-centrale	Amer-centrale	Centrale Rotterdam	Maasvlakte-centrale	Eemshaven-centrale
Company	VATTENFALL 	RWE	ONYX POWER	uni per	RWE
End date coal	December 23 <sup>rd</sup> 2019	December 31 <sup>st</sup> 2024	December 31 <sup>st</sup> 2029	December 31 <sup>st</sup> 2029	December 31 <sup>st</sup> 2029

Lower estimate

53,1 EUR mln (2020)

# Netherlands

Energy-plant	Hemweg-centrale	Amer-centrale	Centrale Rotterdam	Maasvlakte-centrale	Eemshaven-centrale
Company	VATTENFALL 	RWE	ONYX POWER	uni per	RWE
End date coal	December 23 <sup>rd</sup> 2019	December 31 <sup>st</sup> 2024	December 31 <sup>st</sup> 2029	December 31 <sup>st</sup> 2029	December 31 <sup>st</sup> 2029

Lower estimate

53,1 EUR mln (2020)

213 EUR mln (2020)

# Netherlands

Energy-plant	Hemweg-centrale	Amer-centrale	Centrale Rotterdam	Maasvlakte-centrale	Eemshaven-centrale
Company	VATTENFALL 	RWE	ONYX POWER	uni per	RWE
End date coal	December 23 <sup>rd</sup> 2019	December 31 <sup>st</sup> 2024	December 31 <sup>st</sup> 2029	December 31 <sup>st</sup> 2029	December 31 <sup>st</sup> 2029

Lower estimate

53,1 EUR mln (2020)

213 EUR mln (2020)



# Netherlands

Energy-plant	Hemweg-centrale	Amer-centrale	Centrale Rotterdam	Maasvlakte-centrale	Eemshaven-centrale
Company	VATTENFALL 	RWE	ONYX POWER	uni per	RWE
End date coal	December 23 <sup>rd</sup> 2019	December 31 <sup>st</sup> 2024	December 31 <sup>st</sup> 2029	December 31 <sup>st</sup> 2029	December 31 <sup>st</sup> 2029

Lower estimate

53,1 EUR mln (2020)

213 EUR mln (2020)

Upper estimate

2 EUR bn (2020)

1 EUR bn (2020)

# Netherlands

Energy-plant	Hemweg-centrale	Amer-centrale	Centrale Rotterdam	Maasvlakte-centrale	Eemshaven-centrale
Company	VATTENFALL 	RWE	ONYX POWER	uni per	RWE
End date coal	December 23 <sup>rd</sup> 2019	December 31 <sup>st</sup> 2024	December 31 <sup>st</sup> 2029	December 31 <sup>st</sup> 2029	December 31 <sup>st</sup> 2029

Lower estimate

53,1 EUR mln (2020)

213 EUR mln (2020)

Upper estimate

2 EUR bn (2020)

1 EUR bn (2020)

# Netherlands

Energy-plant	Hemweg-centrale	Amer-centrale	Centrale Rotterdam	Maasvlakte-centrale	Eemshaven-centrale
Company	VATTENFALL 	RWE	ONYX POWER 	uni per 	RWE
End date coal	December 23 <sup>rd</sup> 2019	December 31 <sup>st</sup> 2024	December 31 <sup>st</sup> 2029	December 31 <sup>st</sup> 2029	December 31 <sup>st</sup> 2029

Lower estimate

53,1 EUR mln (2020)

213 EUR mln (2020)

Upper estimate

2 EUR bn (2020)

1 EUR bn (2020)

# Netherlands

Energy-plant	Hemweg-centrale	Amer-centrale	Centrale Rotterdam	Maasvlakte-centrale	Eemshaven-centrale
Company	VATTENFALL 	RWE	ONYX POWER	uni per	RWE
End date coal	December 23 <sup>rd</sup> 2019	December 31 <sup>st</sup> 2024	December 31 <sup>st</sup> 2029	December 31 <sup>st</sup> 2029	December 31 <sup>st</sup> 2029

Lower estimate

53,1 EUR mln (2020)

213 EUR mln (2020)

Upper estimate

2 EUR bn (2020)

1 EUR bn (2020)

# Netherlands

Energy-plant	Hemweg-centrale	Amer-centrale	Centrale Rotterdam	Maasvlakte-centrale	Eemshaven-centrale
Company	VATTENFALL	RWE	ONYX POWER	uni per	RWE
End date coal	December 23 <sup>rd</sup> 2019	December 31 <sup>st</sup> 2024	December 31 <sup>st</sup> 2029	December 31 <sup>st</sup> 2029	December 31 <sup>st</sup> 2029



Lower estimate 53,1 EUR mln (2020)

213 EUR mln (2020)

Upper estimate

2 EUR bn (2020)

1 EUR bn (2020)

# Netherlands

Energy-plant	Hemweg-centrale	Amer-centrale	Centrale Rotterdam	Maasvlakte-centrale	Eemshaven-centrale
Company	VATTENFALL 	RWE	ONYX POWER	uni per	RWE
End date coal	December 23 <sup>rd</sup> 2019	December 31 <sup>st</sup> 2024	December 31 <sup>st</sup> 2029	December 31 <sup>st</sup> 2029	December 31 <sup>st</sup> 2029



Lower estimate 53,1 EUR mln (2020)

213 EUR mln (2020)

9,1 EUR bn (2020)

Upper estimate

2 EUR bn (2020)

1 EUR bn (2020)

# Netherlands

Energy-plant	Hemweg-centrale	Amer-centrale	Centrale Rotterdam	Maasvlakte-centrale	Eemshaven-centrale
Company	VATTENFALL 	RWE	ONYX POWER	uni per	RWE
End date coal	December 23 <sup>rd</sup> 2019	December 31 <sup>st</sup> 2024	December 31 <sup>st</sup> 2029	December 31 <sup>st</sup> 2029	December 31 <sup>st</sup> 2029



Lower estimate

53,1 EUR mln (2020)

213 EUR mln (2020)

9,1 EUR bn (2020)

Upper estimate

2 EUR bn (2020)

1 EUR bn (2020)

# Netherlands

Energy-plant	Hemweg-centrale	Amer-centrale	Centrale Rotterdam	Maasvlakte-centrale	Eemshaven-centrale
Company	VATTENFALL 	RWE	ONYX POWER	uni per	RWE
End date coal	December 23 <sup>rd</sup> 2019	December 31 <sup>st</sup> 2024	December 31 <sup>st</sup> 2029	December 31 <sup>st</sup> 2029	December 31 <sup>st</sup> 2029



Lower estimate

53,1 EUR mln (2020)

213 EUR mln (2020)

9,1 EUR bn (2020)

Upper estimate

2 EUR bn (2020)

1 EUR bn (2020)



# Netherlands



## Transition to a Diversified Economy: an inclusive, sustainable and just development approach for the Colombian coal mining regions

Published: January 1 2021 | 1:00

Updated: December 14 2020 | 0:00

Energy-plant	Hemweg-centrale	Amer-centrale	Centrale Rotterdam	Maasvlakte-	Eemshaven-
Company	VATTENFALL	RWE	ONY POWER		
End date coal	December 23 <sup>rd</sup> 2019	December 31 <sup>st</sup> 2024	December 2029		

Lower estimate

53,1 EUR mln (2020)

213 EUR mln (2020)

9,1 EUR bn (2020)

Upper estimate

2 EUR bn (2020)

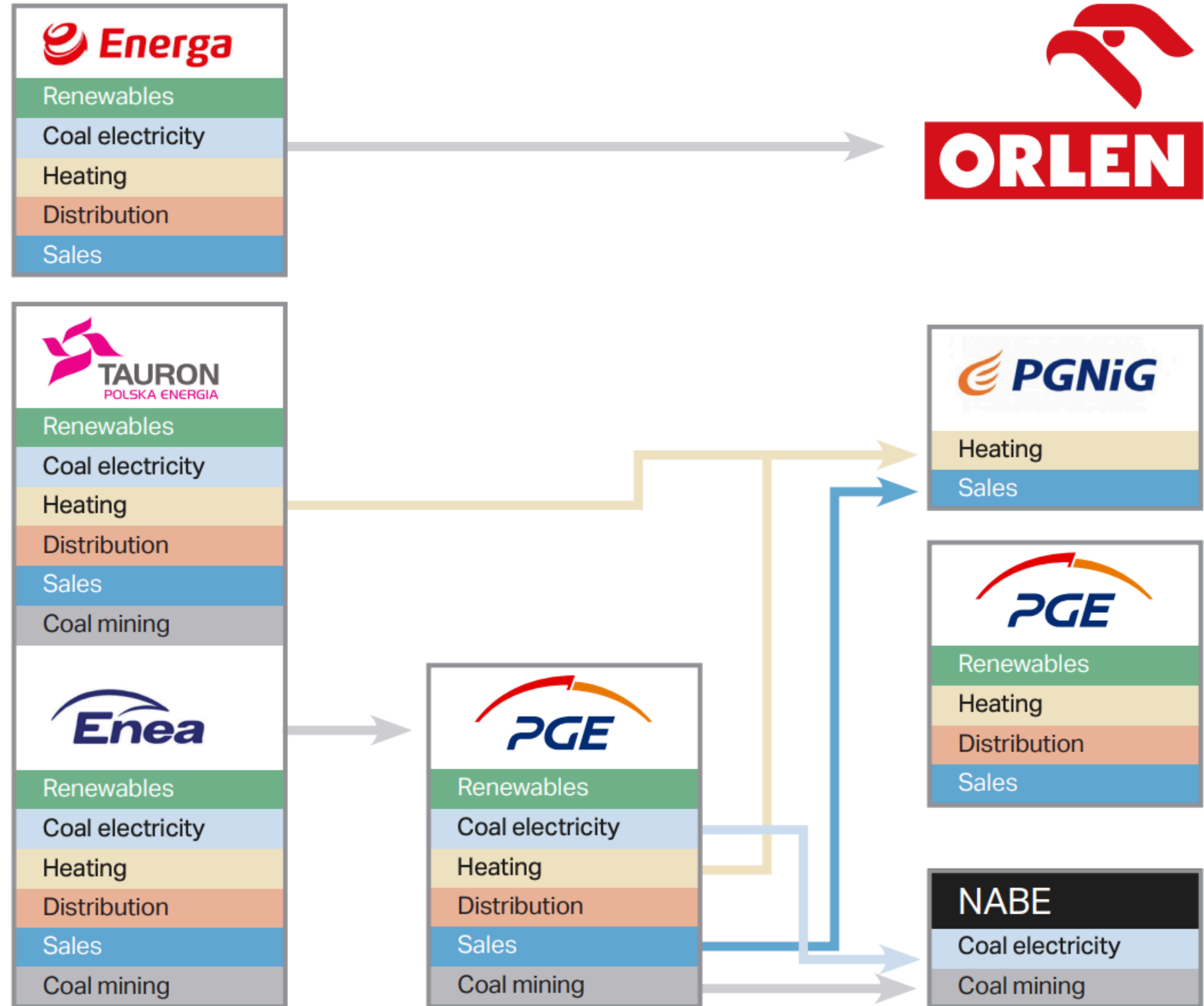
1 EUR bn (2020)

589 EUR mln (2020)

# Poland

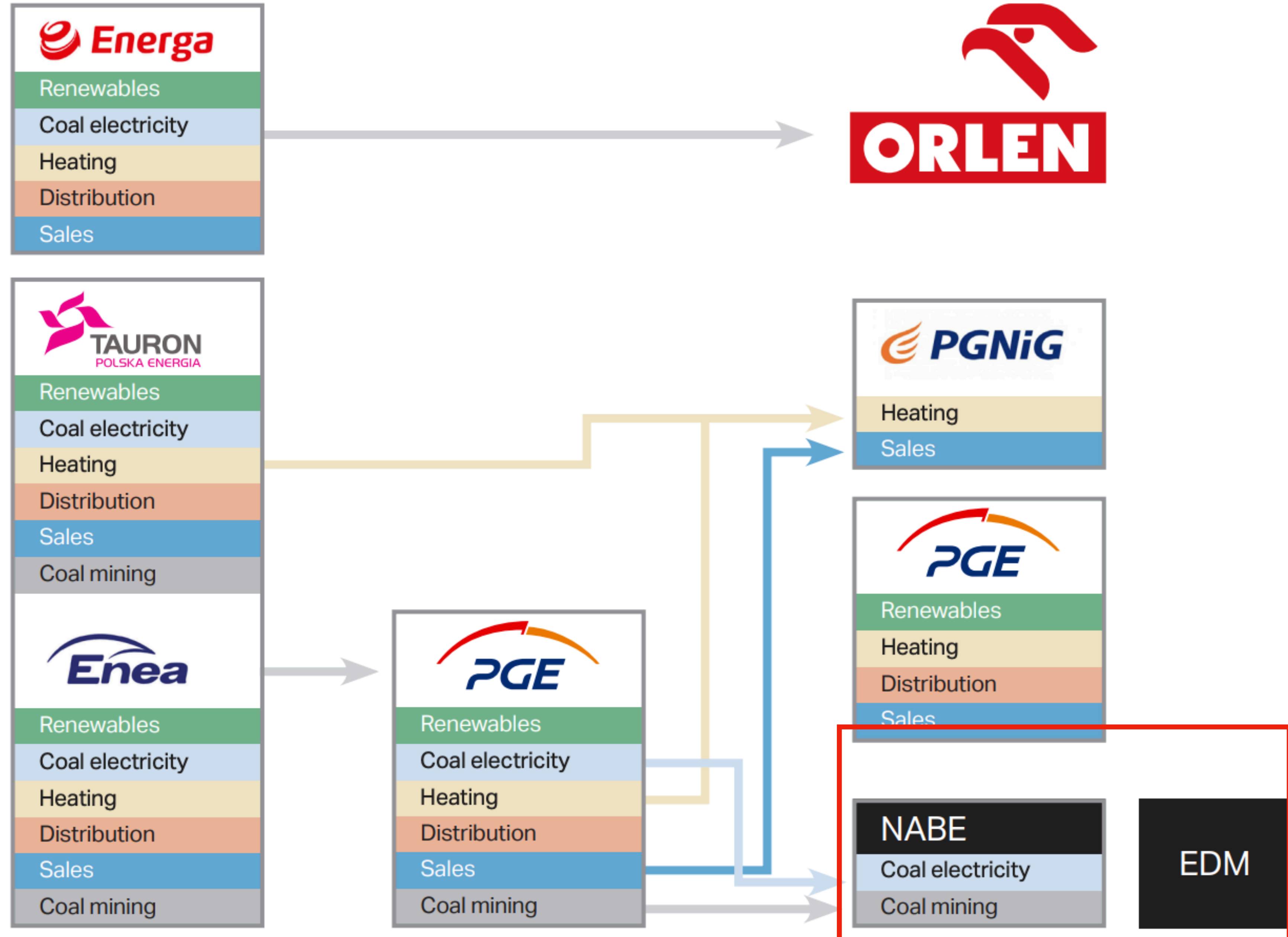
# Poland

Current state → Transformation → Target state



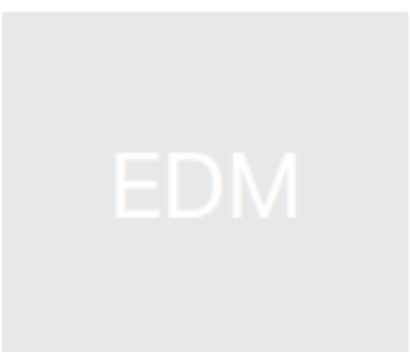
# Poland

Current state → Transformation → Target state



# Poland

Current state → Transformation → Target state



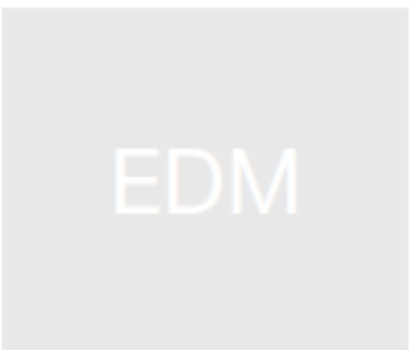
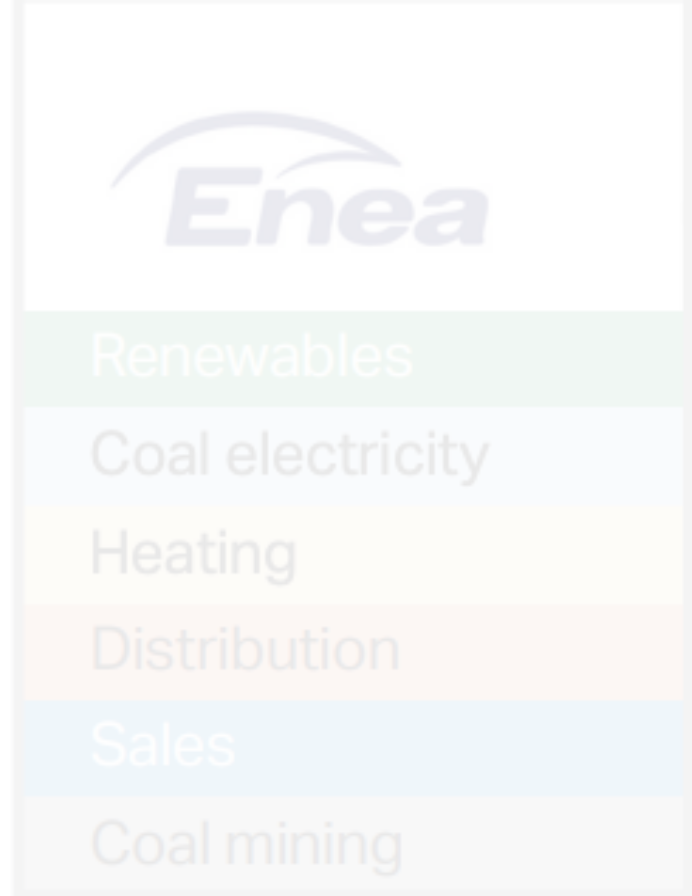
# Poland

EDM

Lower estimate

7,2 EUR bn (2020)

Current state → Transformation → Target state

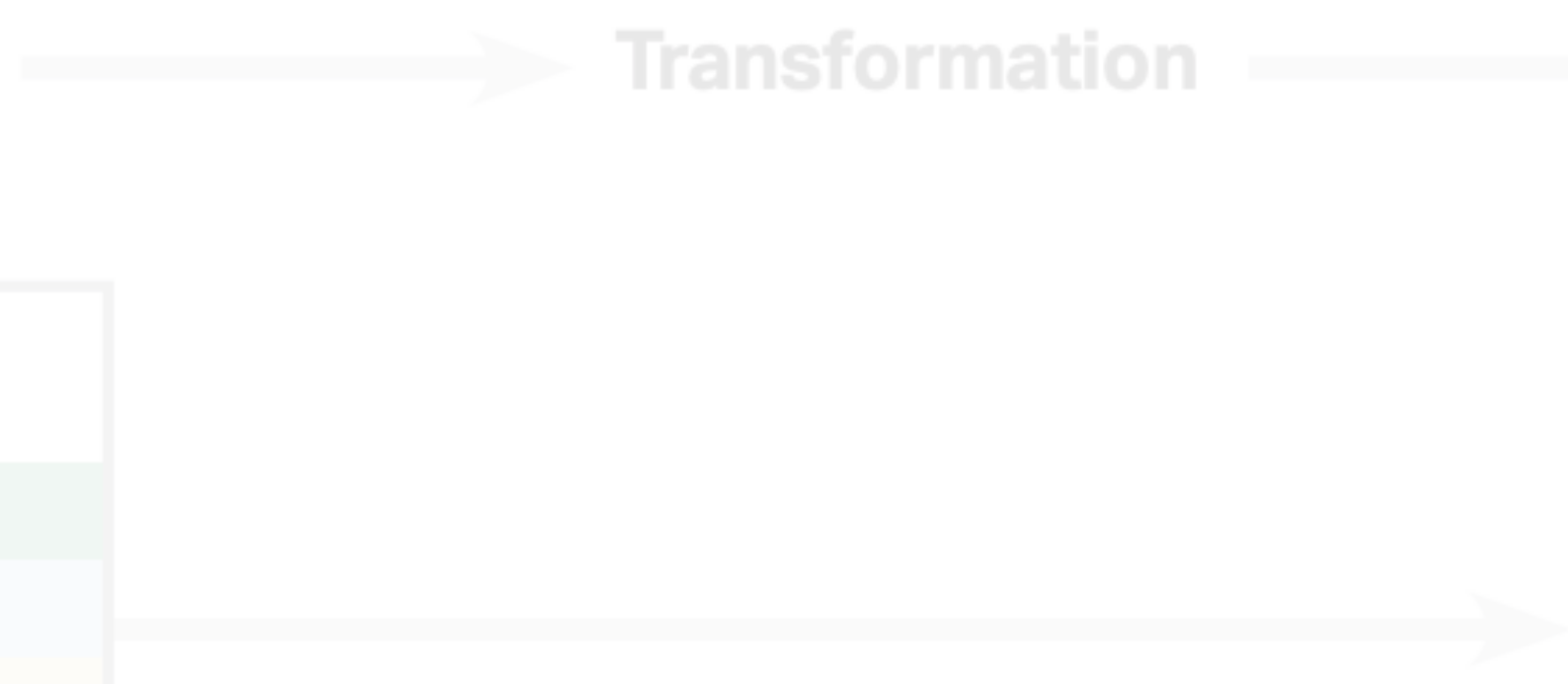


# Poland

Current state → Transformation → Target state

**EDM**

Lower estimate  
7,2 EUR bn (2020)

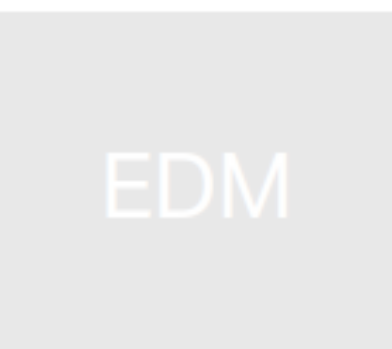
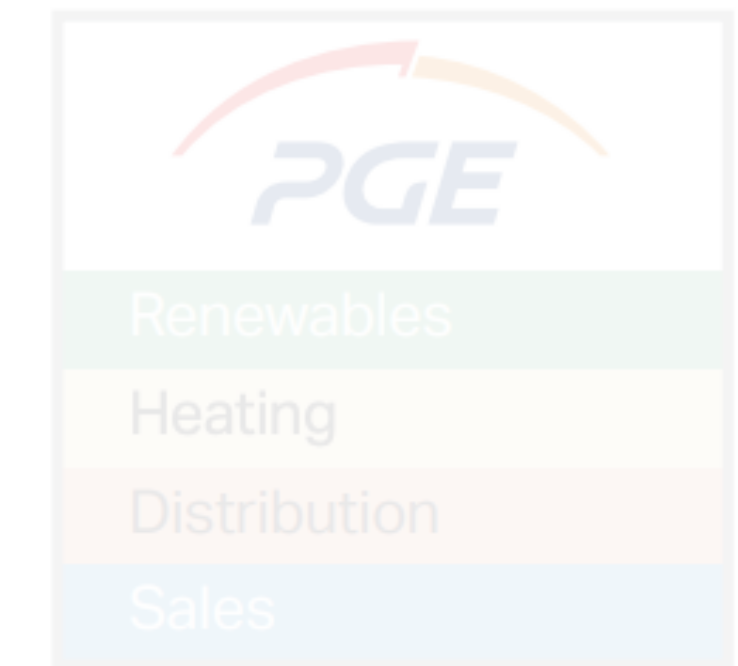
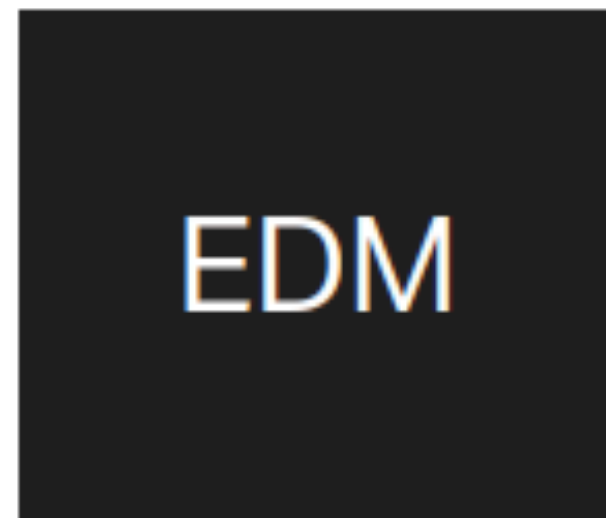


# Poland

Current state

Transformation

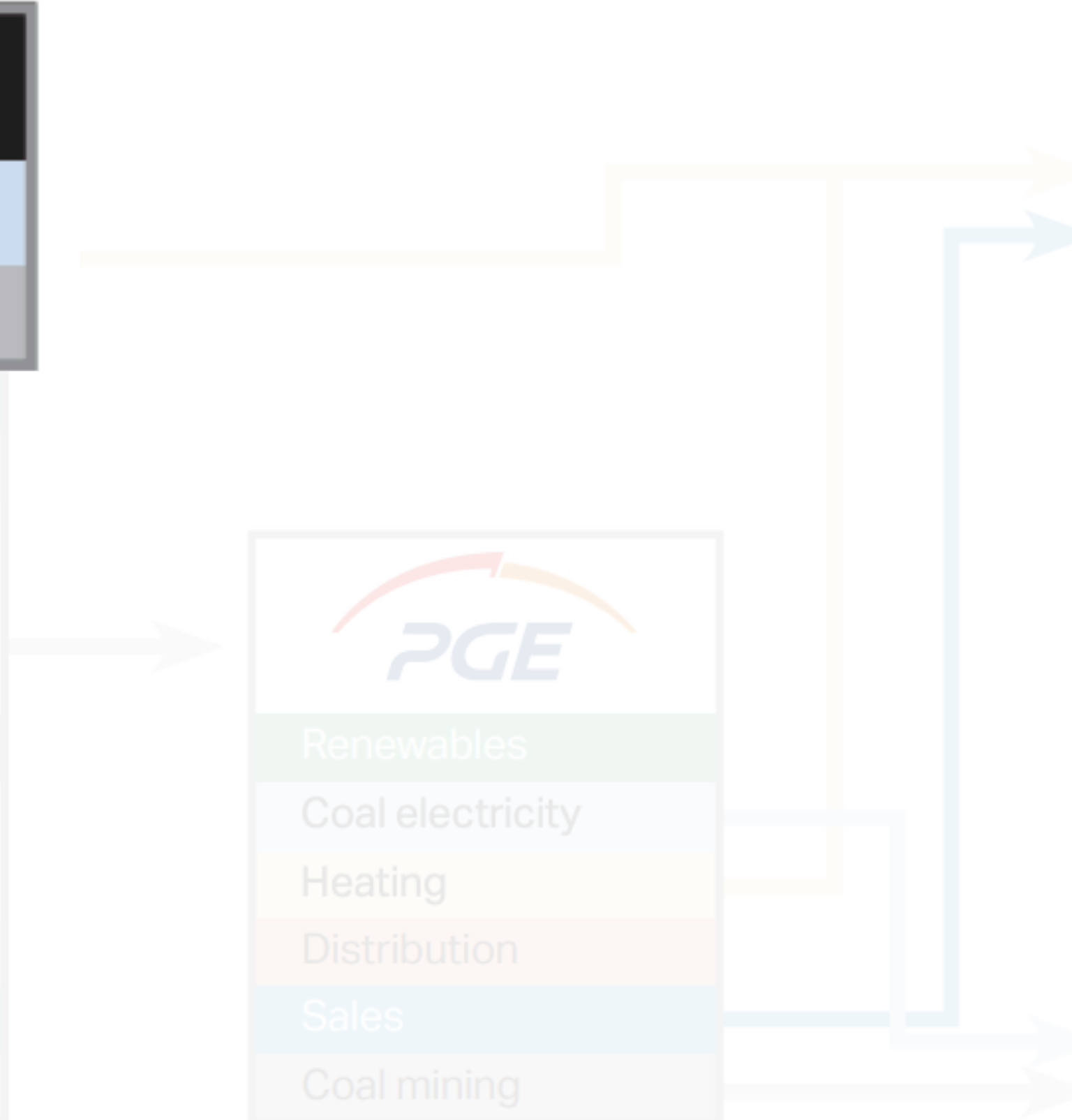
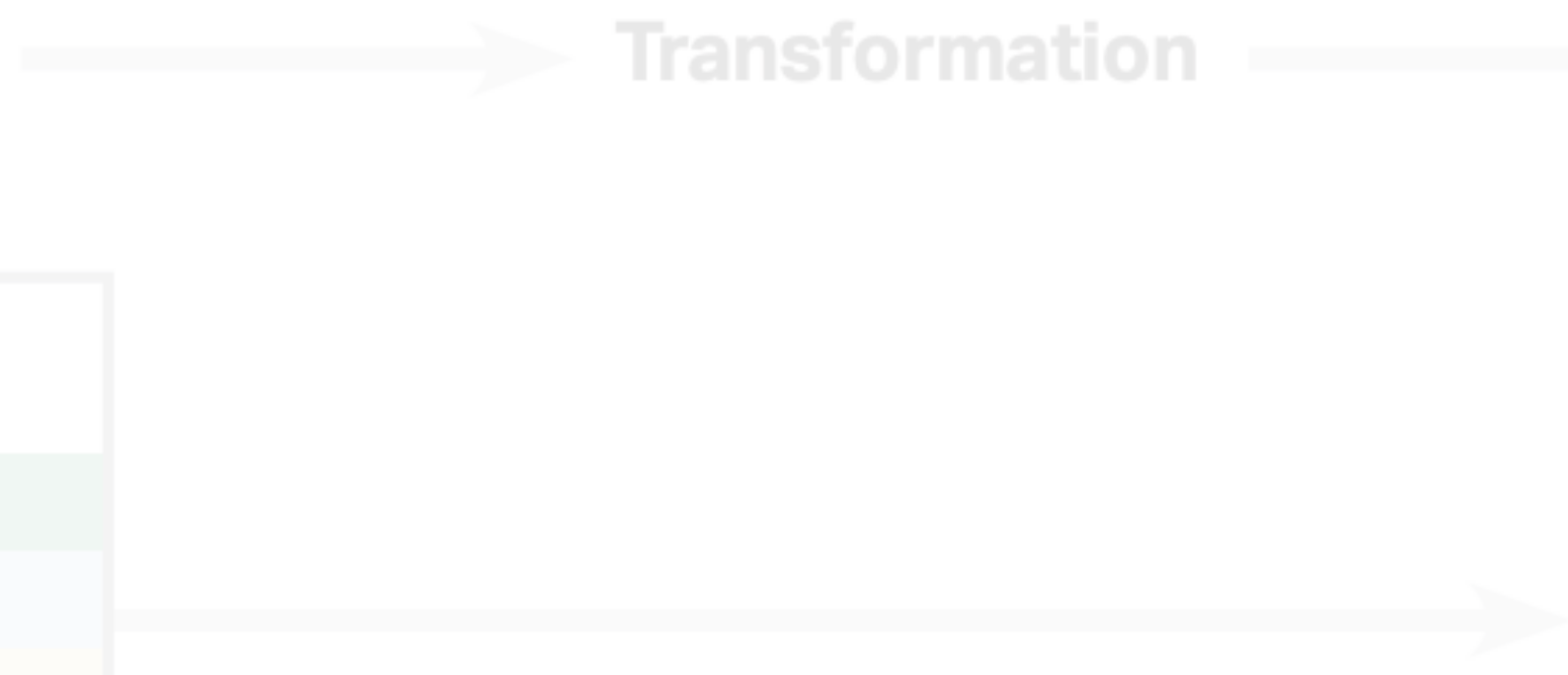
Target state



Lower estimate

7,2 EUR bn (2020)

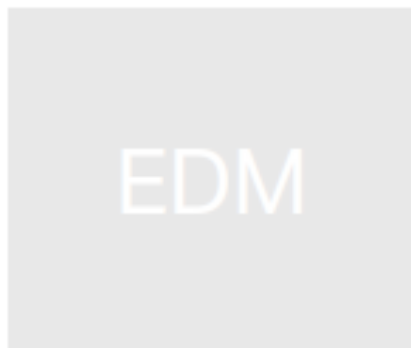
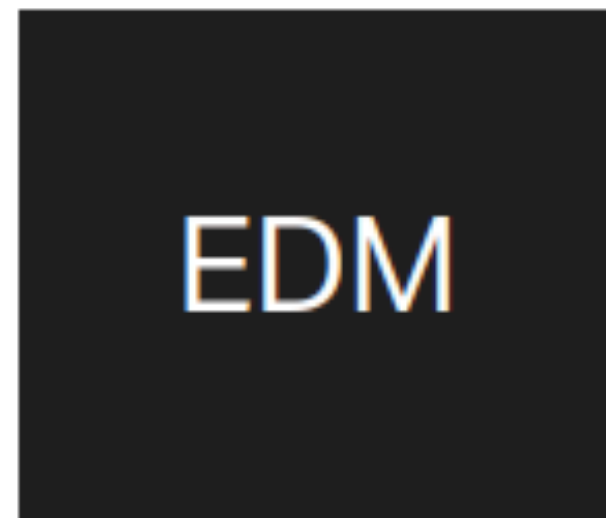
- 810 EUR mln (2020)





# Poland

Current state → Transformation → Target state



Lower estimate

7,2 EUR bn (2020)

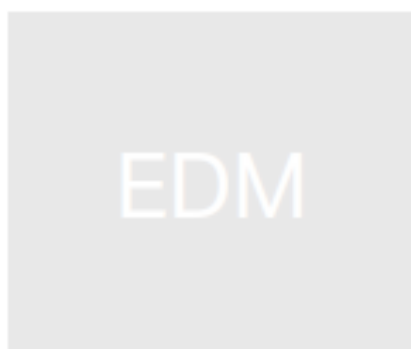
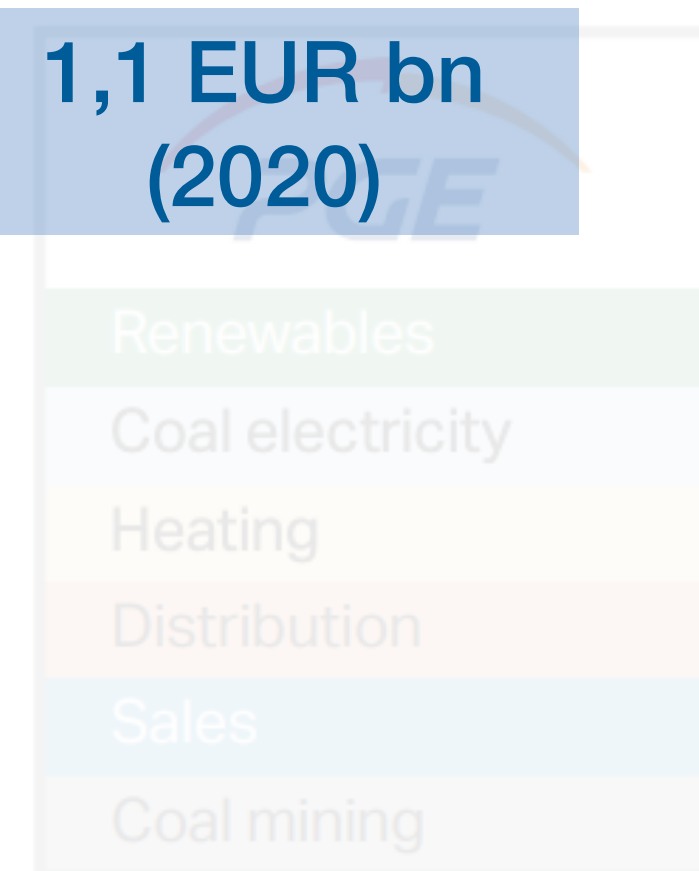
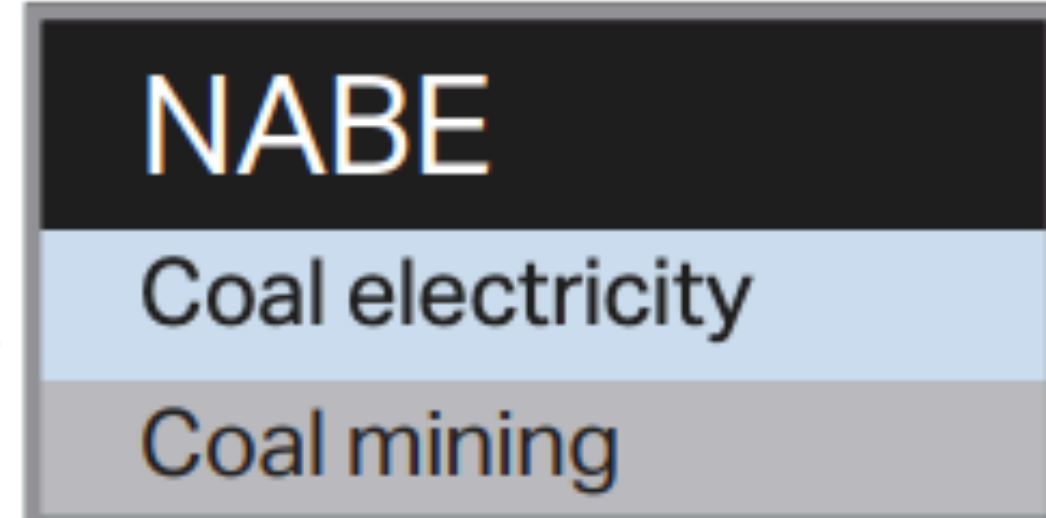
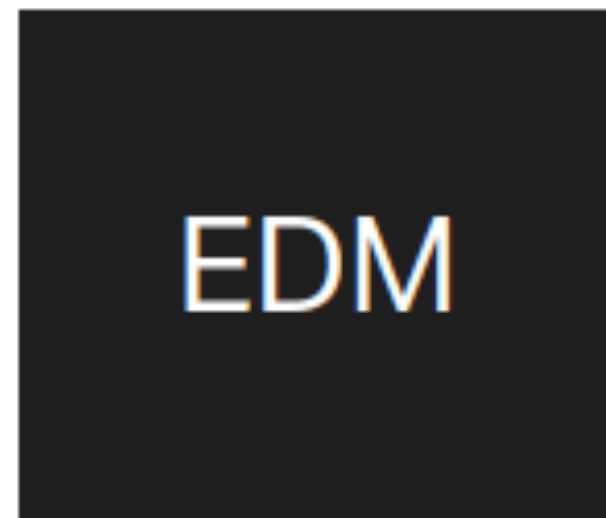
- 810 EUR mln (2020)

# Poland

Current state

Transformation

Target state

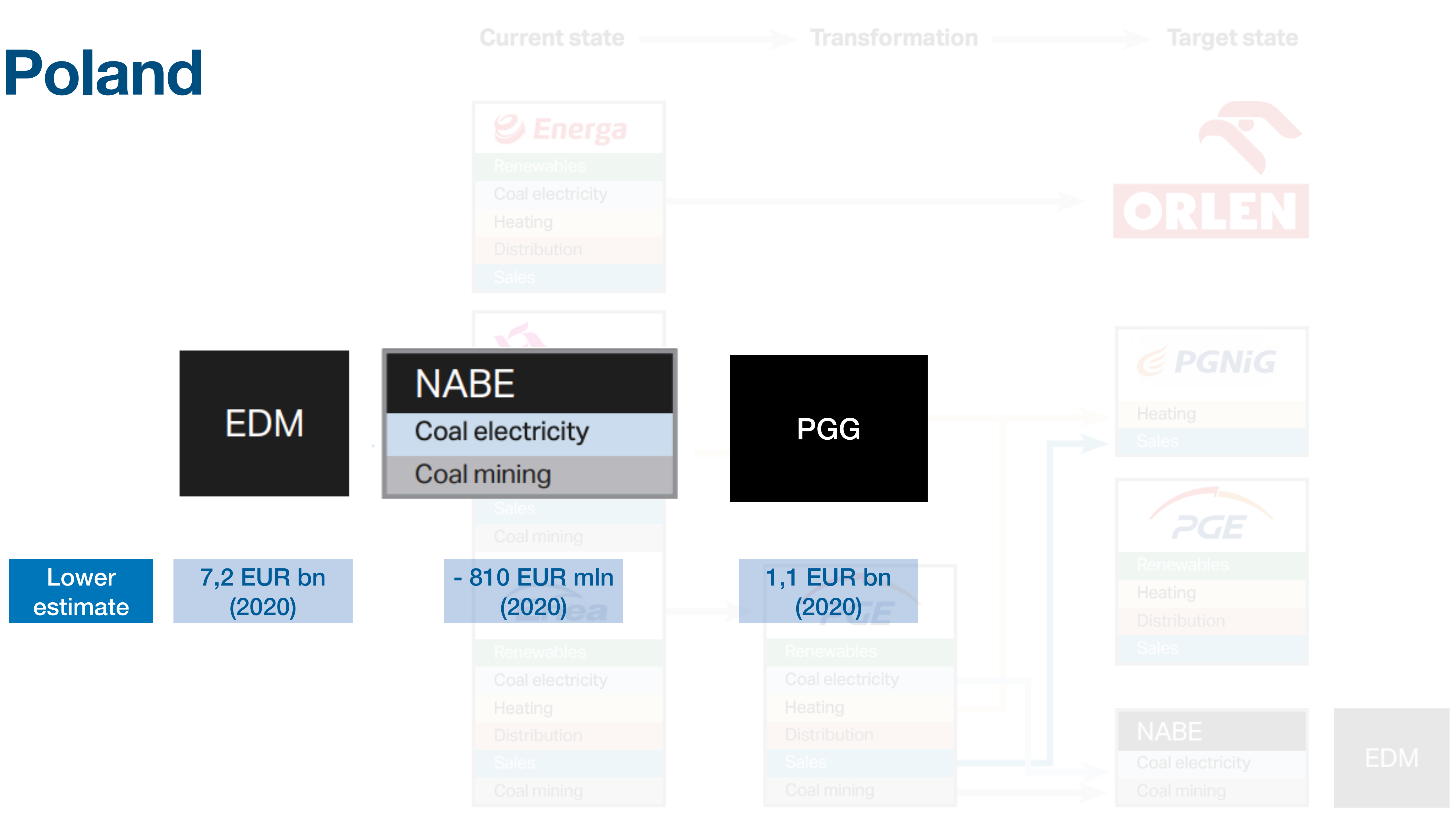


Lower estimate

7,2 EUR bn (2020)

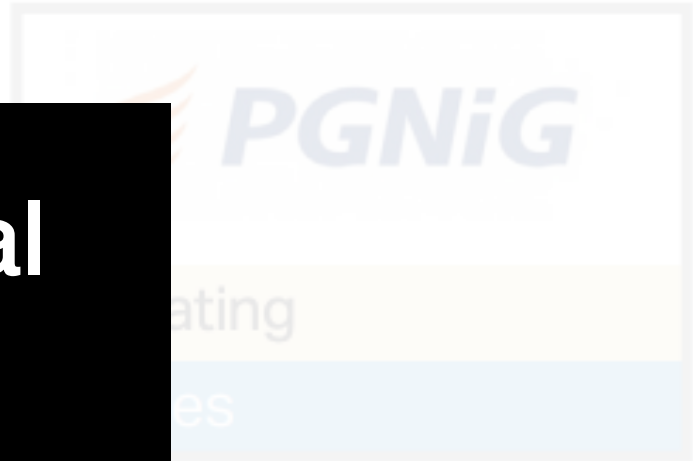
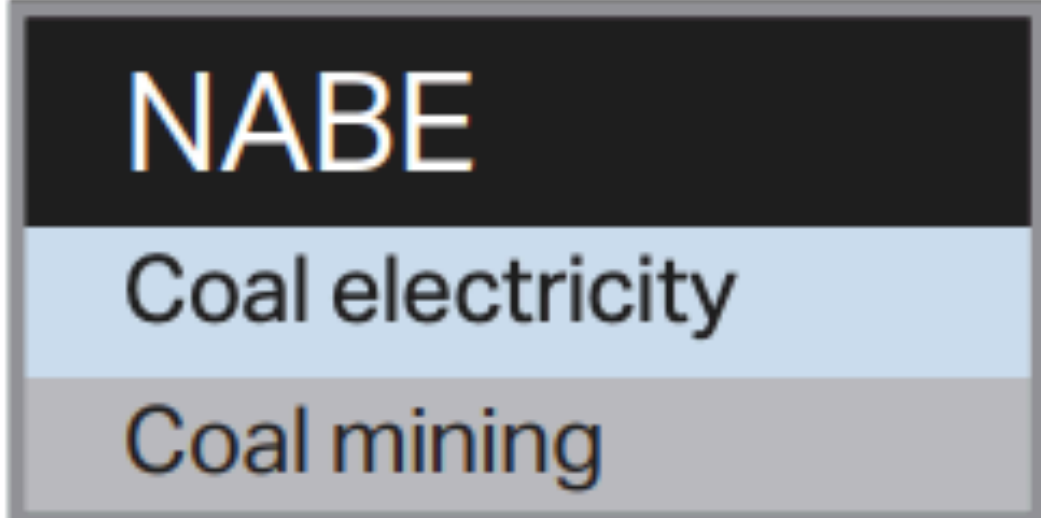
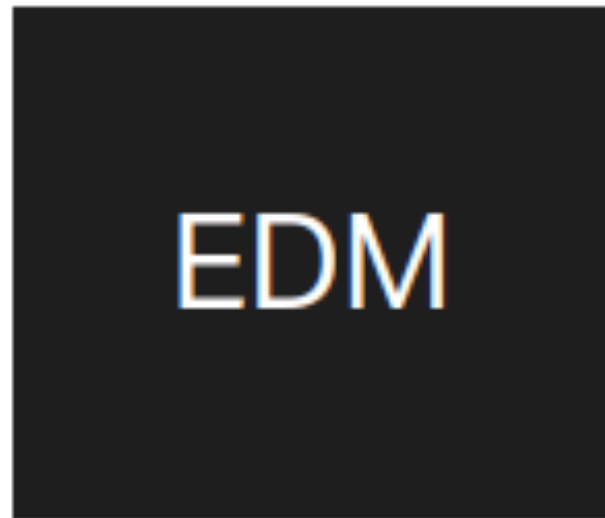
- 810 EUR mln (2020)

1,1 EUR bn (2020)



# Poland

Current state → Transformation → Target state



Lower estimate

7,2 EUR bn (2020)

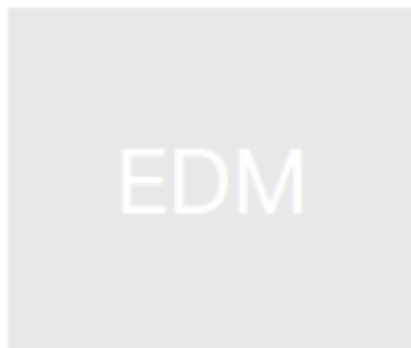
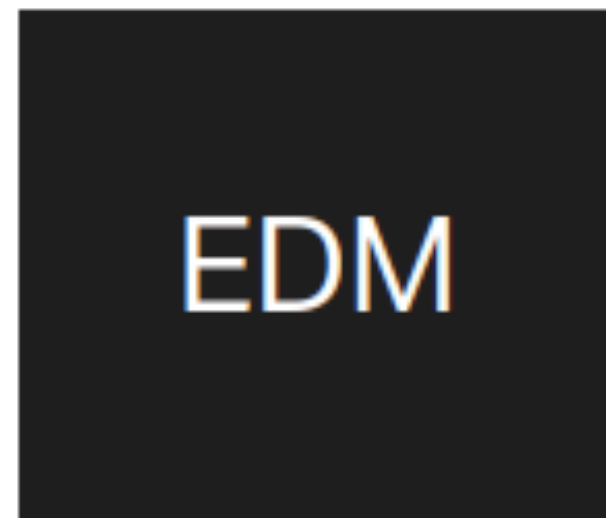
- 810 EUR mln (2020)

1,1 EUR bn (2020)

1,8 EUR bn (2020)

# Poland

Current state → Transformation → Target state



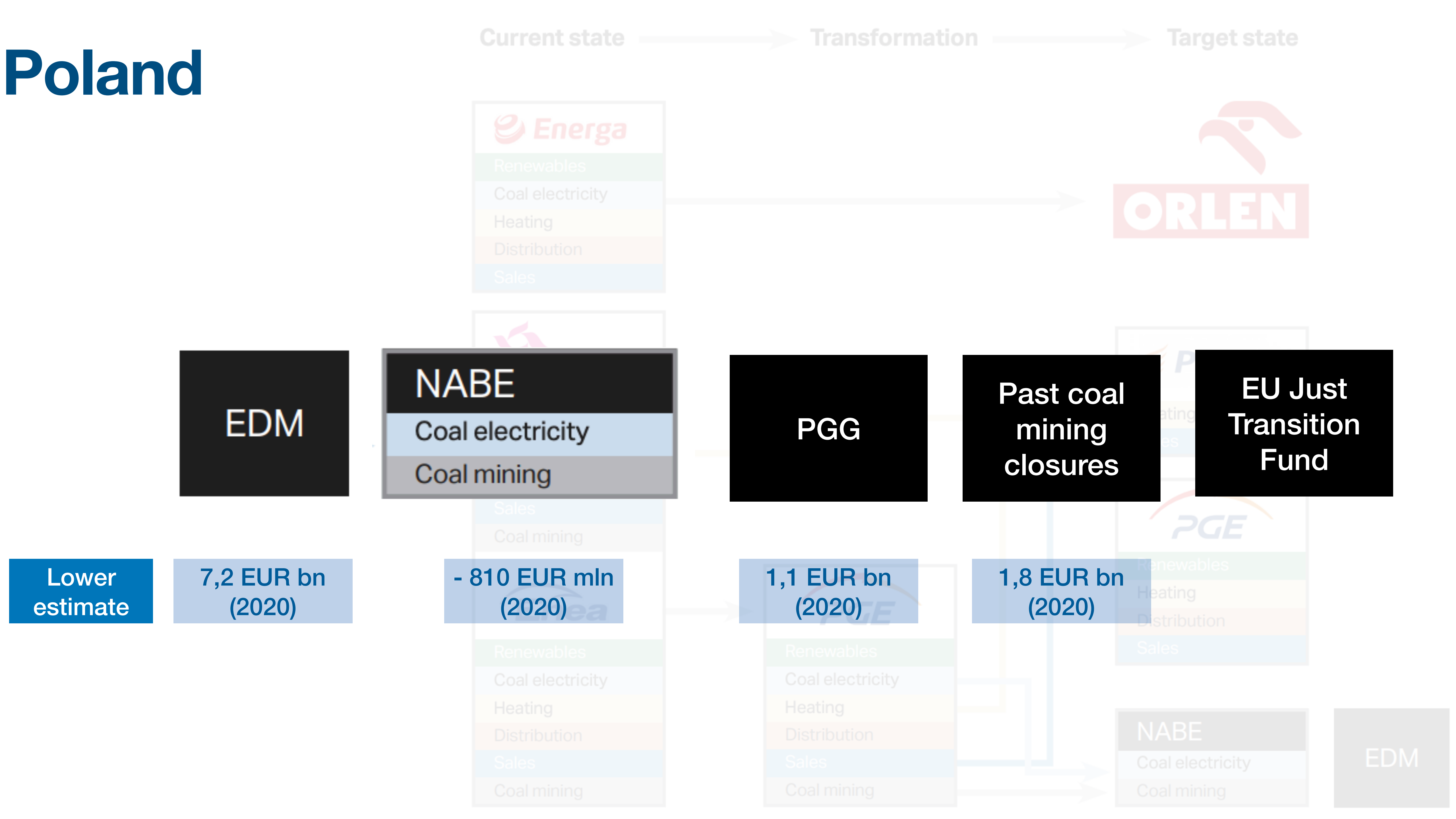
Lower estimate

7,2 EUR bn (2020)

- 810 EUR mln (2020)

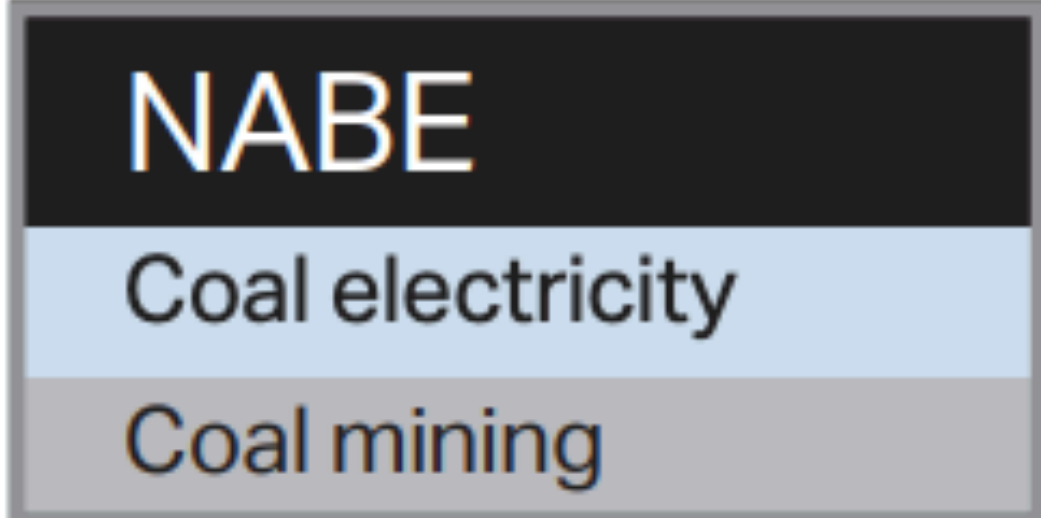
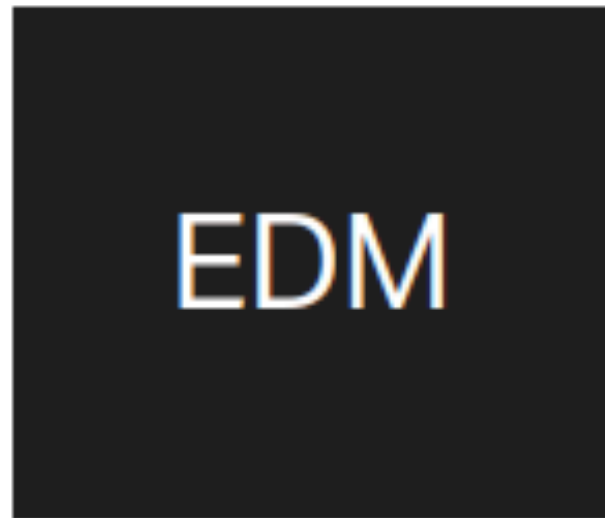
1,1 EUR bn (2020)

1,8 EUR bn (2020)



# Poland

Current state → Transformation → Target state



Lower estimate

7,2 EUR bn (2020)

- 810 EUR mln (2020)

1,1 EUR bn (2020)

1,8 EUR bn (2020)

3,7 EUR bn (2020)

Upper estimate

# Learning from existing coal phase-out schemes

## ... in European countries

- Germany
- Finland
- Spain
- Romania
- Netherlands
- Czech Republic
- Greece
- Slovakia
- Poland
- Ukraine
- Slovenia
- France

## ... and plan to extend to non-European countries

- Canada
- Chile
- South Korea

# Thank you!

## Please reach out with any comments, questions or input!

Online survey: <https://www.surveymonkey.com/r/ZC9G8Z8>

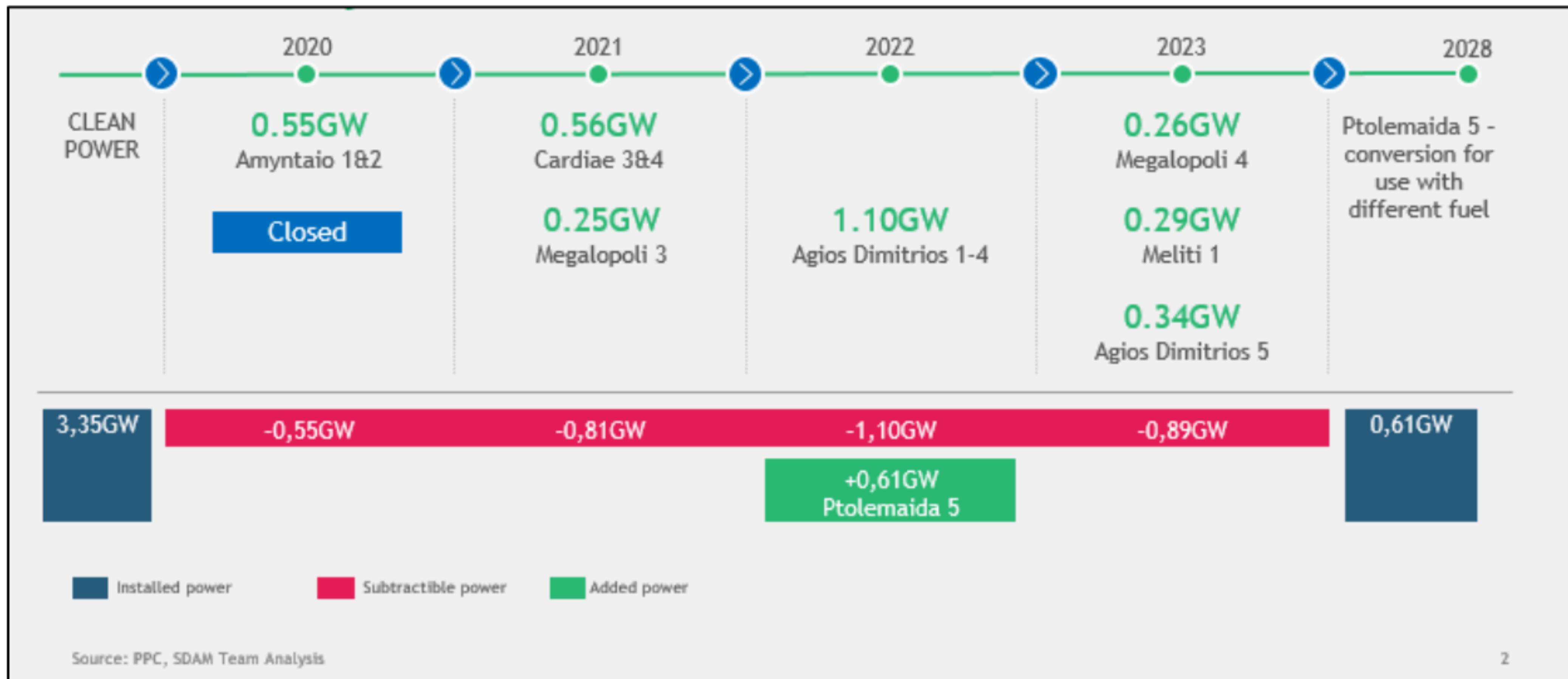
Email: [lolan@chalmers.se](mailto:lolan@chalmers.se)

# Back-ups

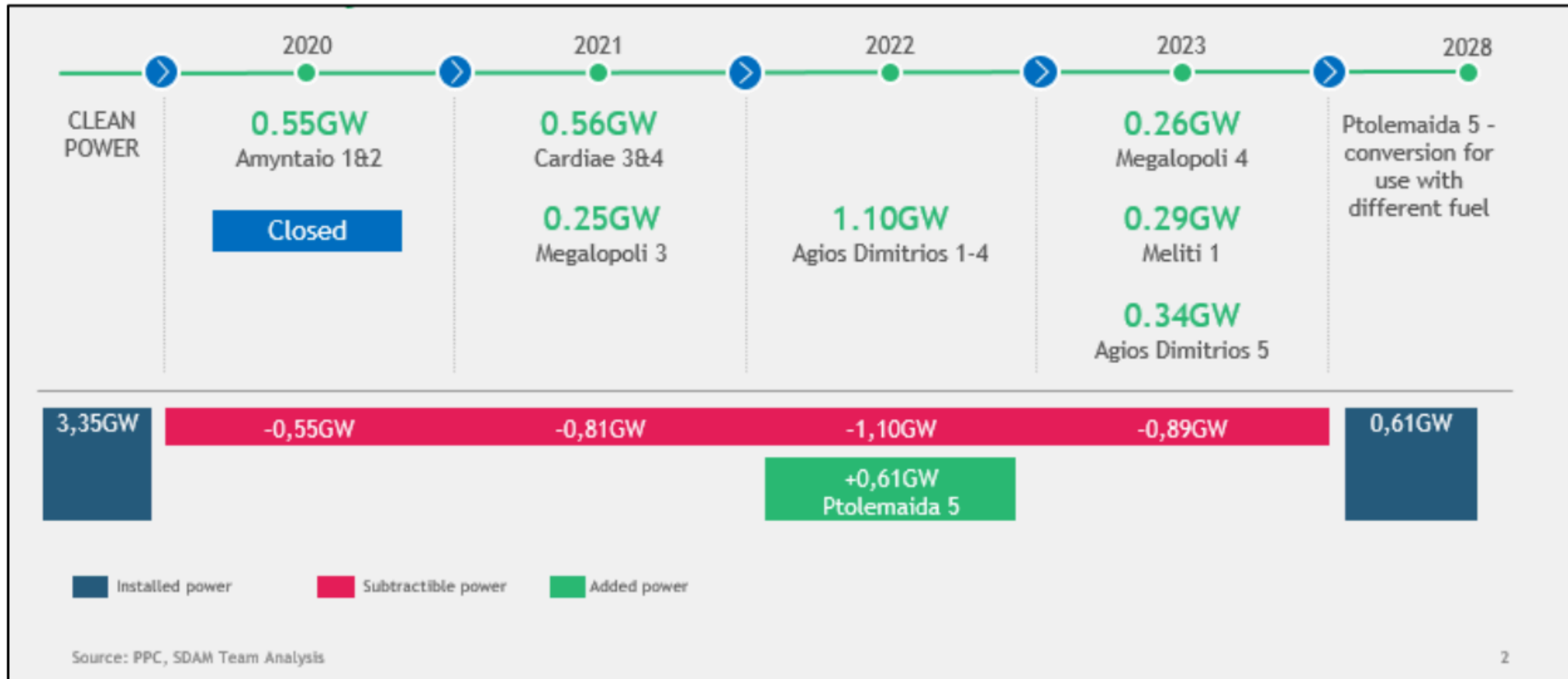




# Greece



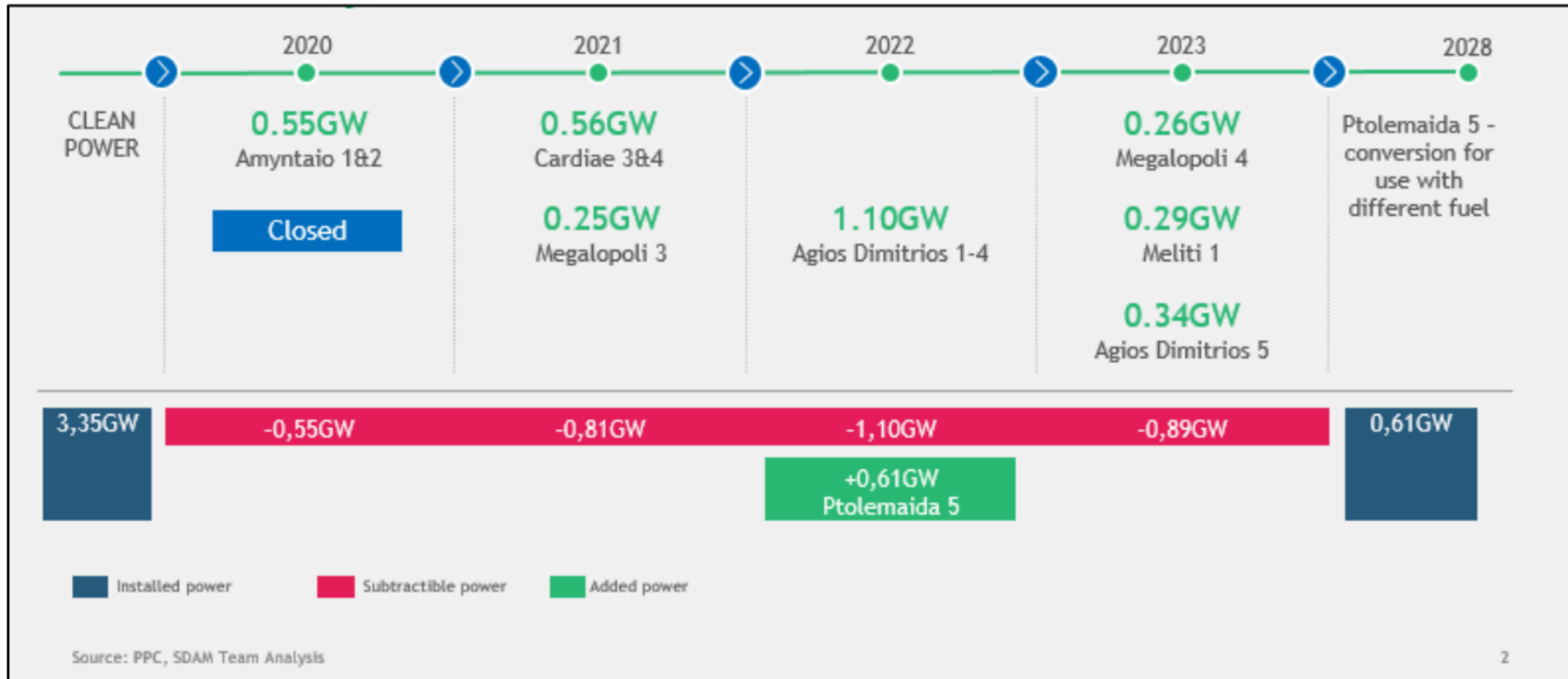
# Greece



Lower estimate

0,3 USD bn (2020)

# Greece

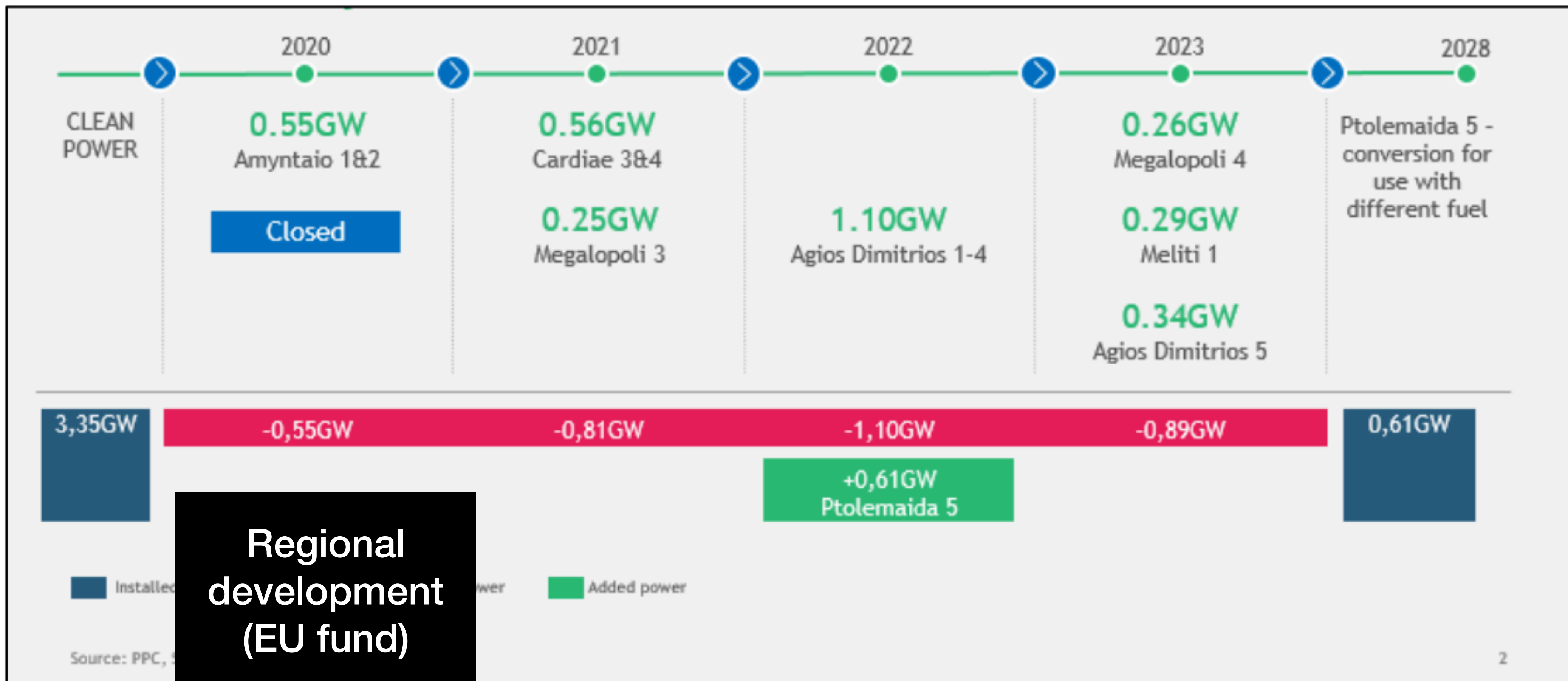


Lower estimate

0,3 USD bn (2020)

Upper estimate

# Greece



Lower estimate

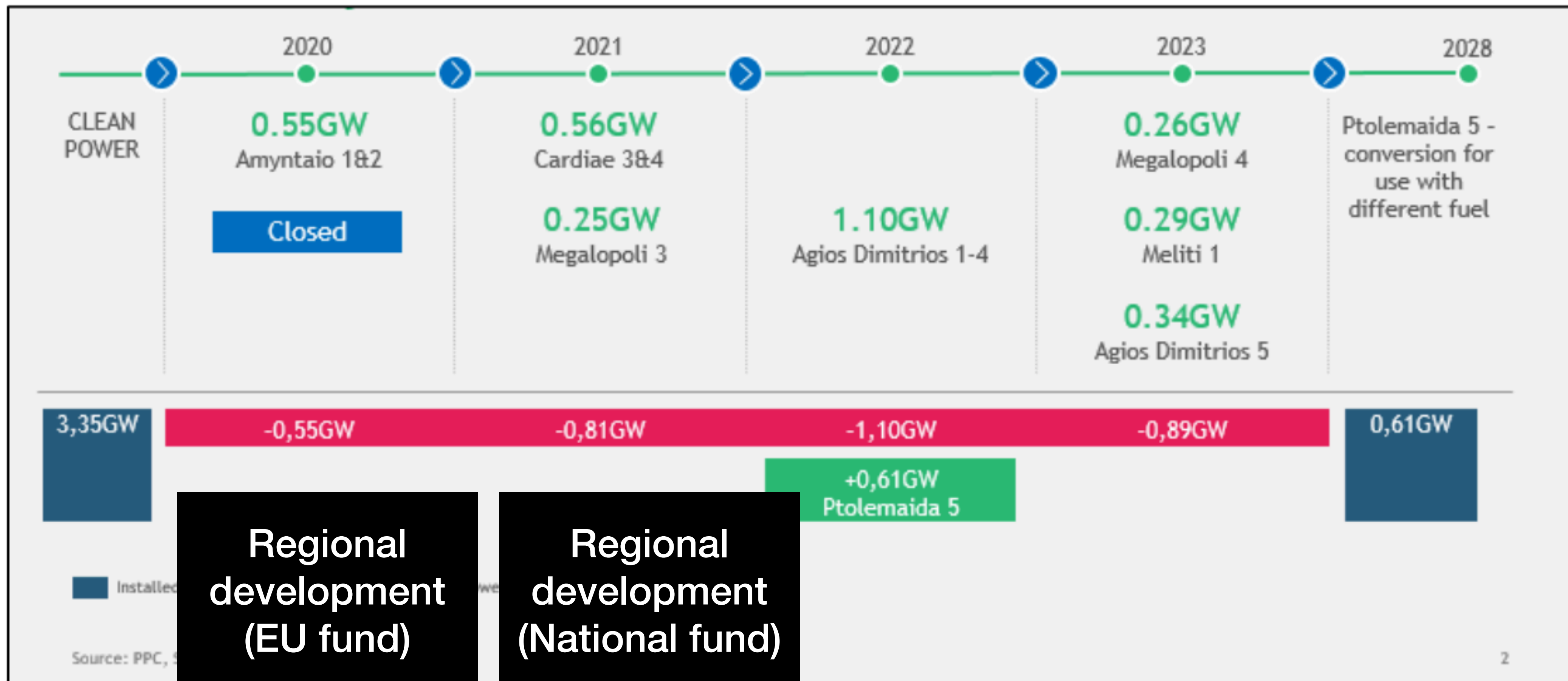
0,3 USD bn (2020)

Upper estimate

0,9 USD bn (2020)

0,2 USD bn (2020)

# Greece



Lower estimate

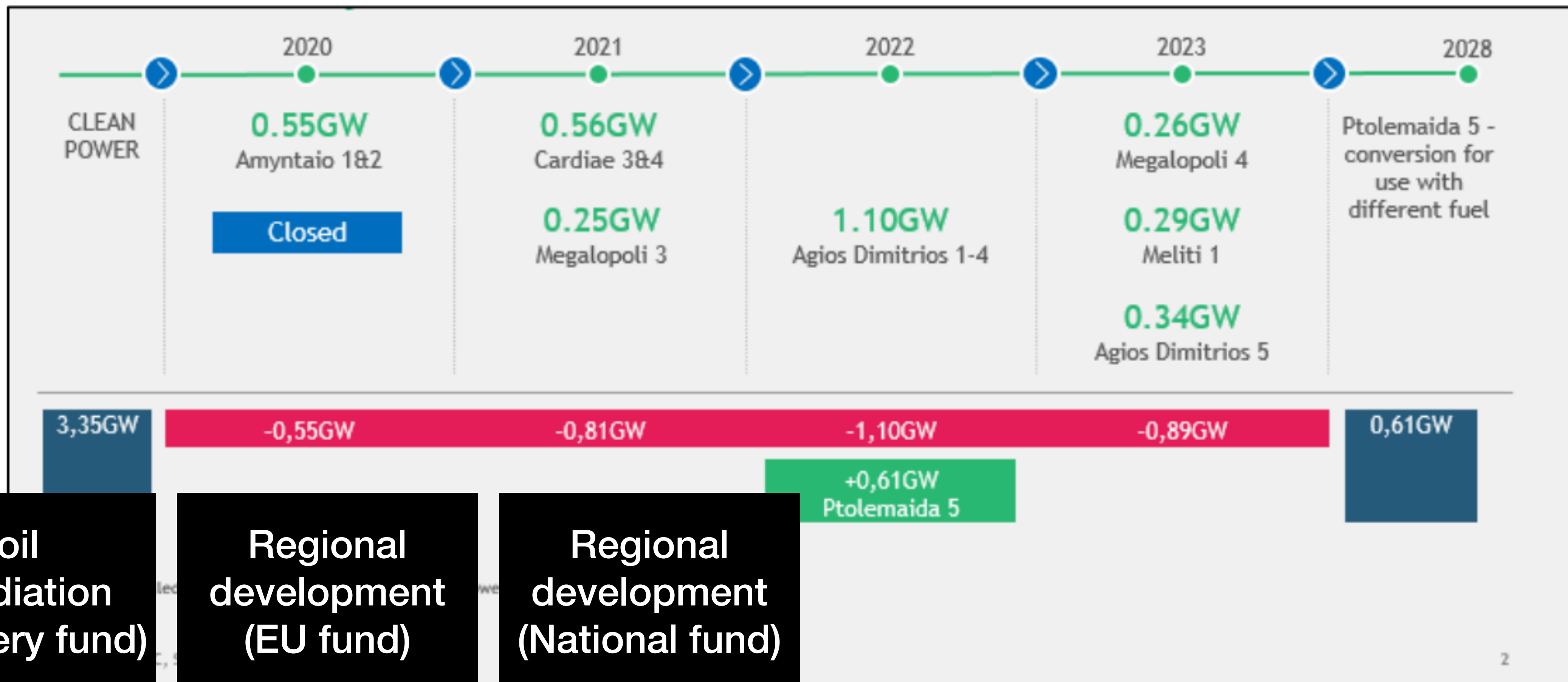
0,3 USD bn (2020)

Upper estimate

0,9 USD bn (2020)

0,2 USD bn (2020)

# Greece



**Lower estimate**  
0,3 USD bn (2020)

**Upper estimate**  
0,9 USD bn (2020)      0,2 USD bn (2020)

# How expensive is it to advance coal phase-out?

• Germany ✓

• Finland ✓

• Spain ✓

• Romania ✓

• Netherlands ✓

• Greece ✓

• Slovakia ✓

• Poland ✓

• Ukraine ✓

• Slovenia ✓

• France ✓

• Canada ✓

• Chile ✓

• South Korea ✓



# How expensive is it to advance coal phase-out?

• Germany ✓

• Finland ✓

• Spain ✓

• Romania ✓

• Netherlands ✓

• Greece ✓

• Slovakia ✓

• Poland ✓

• Ukraine ✓

• Slovenia ✓

• France ✓

• Canada ✓

• Chile ✓

• South Korea ✓

# How expensive is it to advance coal phase-out?

- Germany ✓
- Greece ✓
- Canada ✓

How do the costs of coal mining and coal power phase-out relate to each other in different contexts?

How can we normalise the costs of phasing out coal across countries and transfer this knowledge to emerging cases of coal phase-out?

- France ✓