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European Guarantees of Origin

Pricing and market development

Lawrence Templeton, VP European Natural Gas and Electricity

HUPX, Argus Webinar

11th April 2022

Market Reporting

Consulting

Events

illuminating the markets

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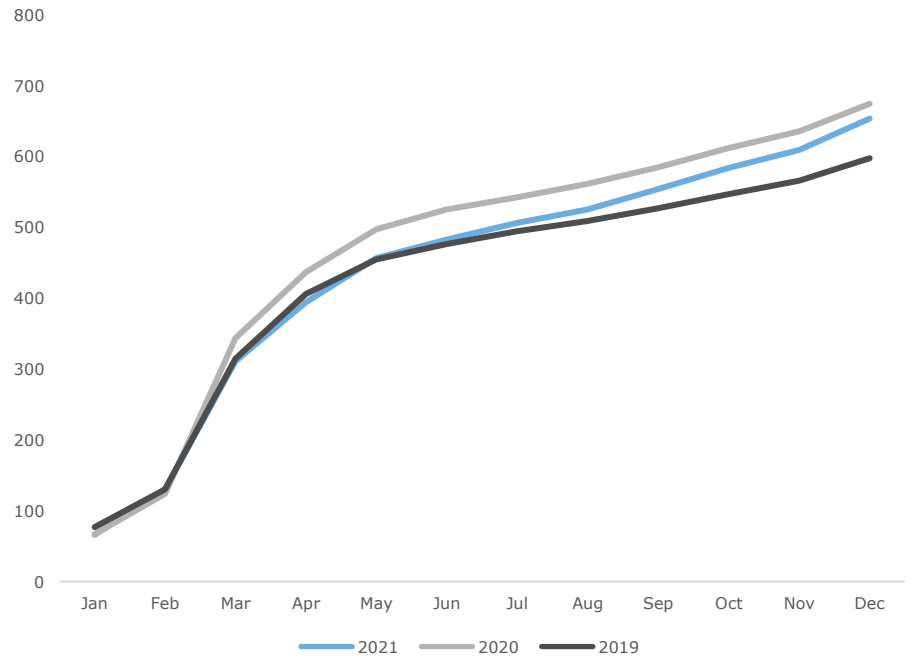
Guarantee of Origin trade grows in Europe

Cancel own domain, GO cumulative, TWh



Source: AIB data

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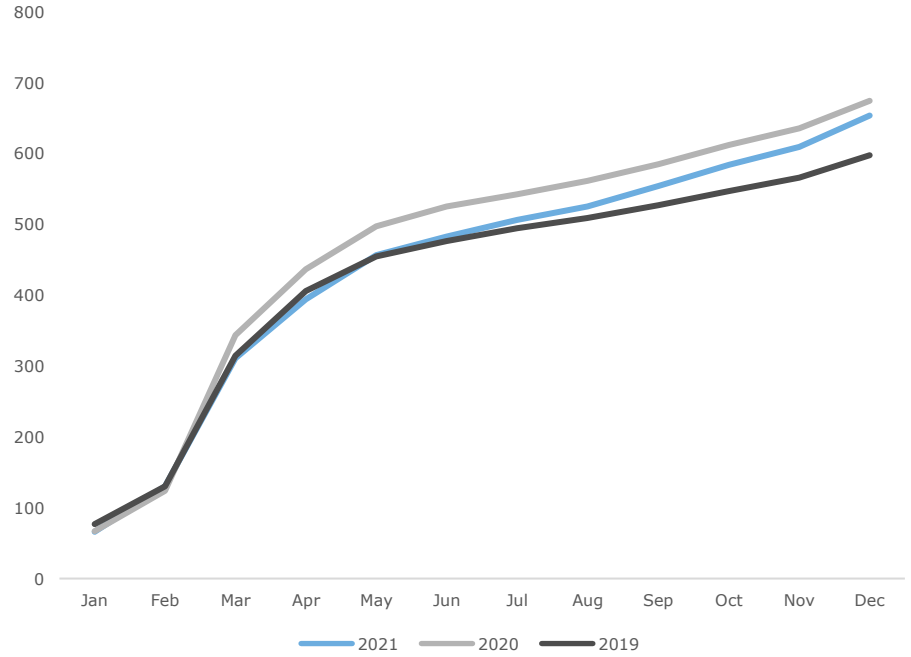
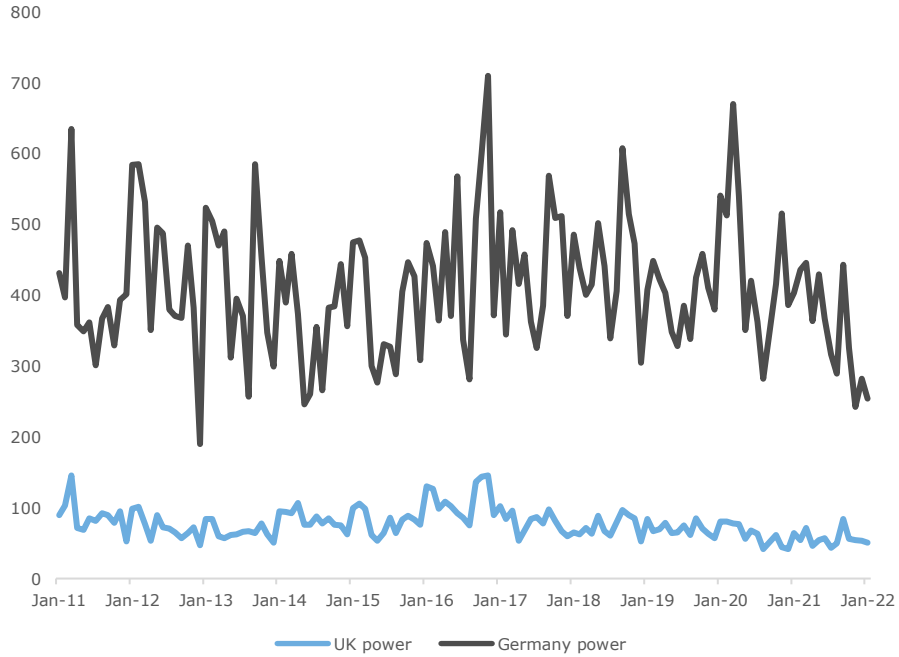
GO trade strong despite lower 4Q21+ power liquidity

Cancel own domain, GO cumulative, TWh



UK and Germany power liquidity (OTC), TWh/m



Source: AIB data and Argus EER published data

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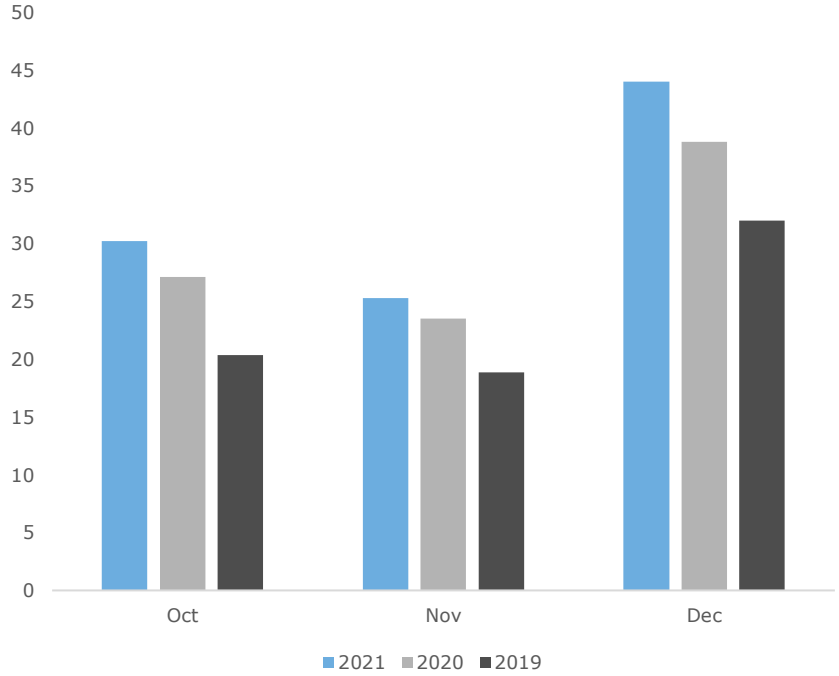
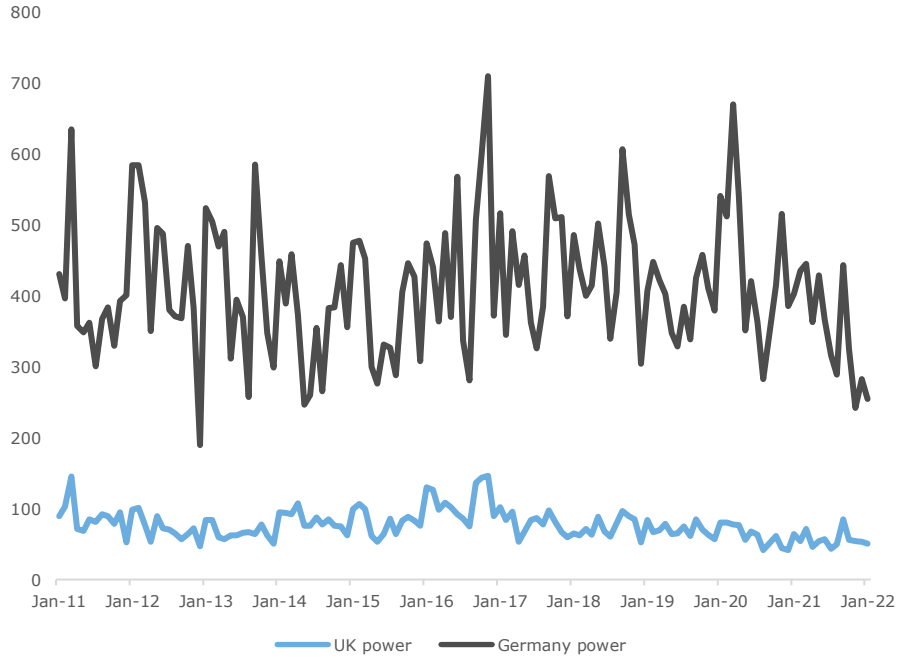
GO trade strong despite lower 4Q21+ power liquidity

Cancel own domain, monthly comparative, 4Q, TWh



UK and Germany power liquidity (OTC), TWh/m



Source: AIB data and Argus EER published data

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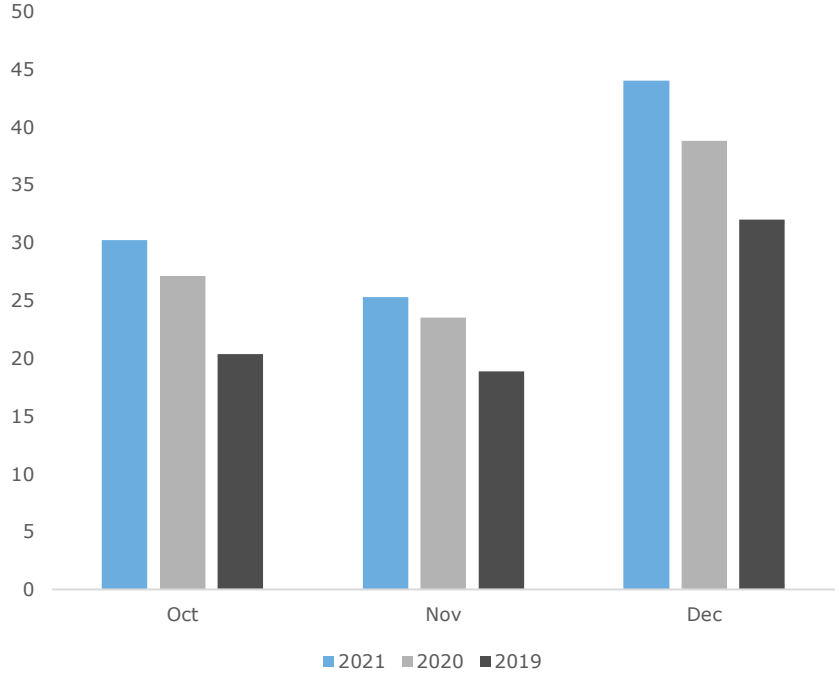
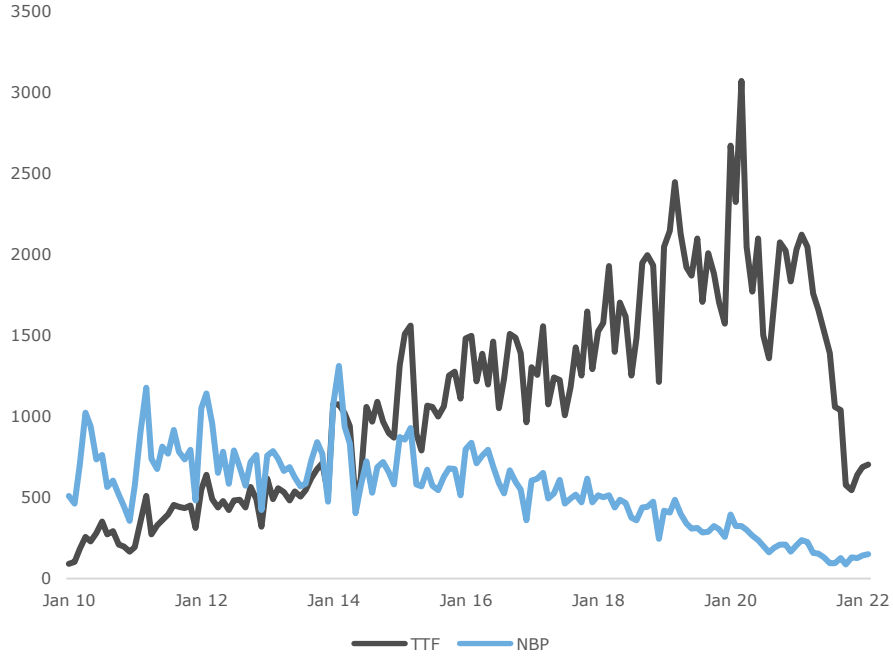
And collapsing 4Q21+ gas market liquidity

Cancel own domain, monthly comparative, 4Q, TWh



TTF, NBP over-the-counter traded volumes, TWh/m



Source: AIB data and Argus EER published data

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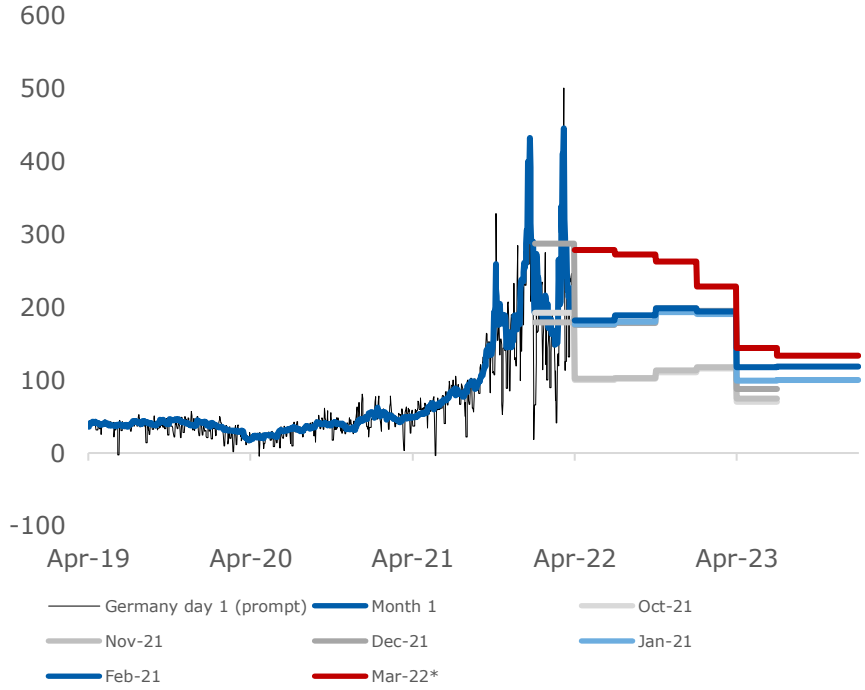
Forward power curve inverts in March 2022

Germany baseload power, €/MWh



Source: Argus European Electricity

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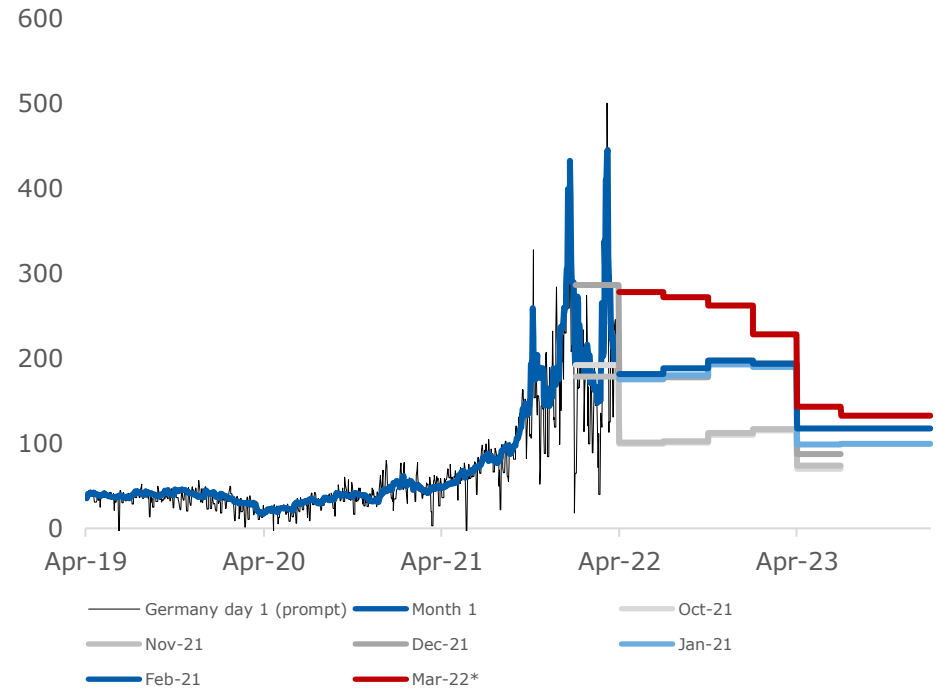
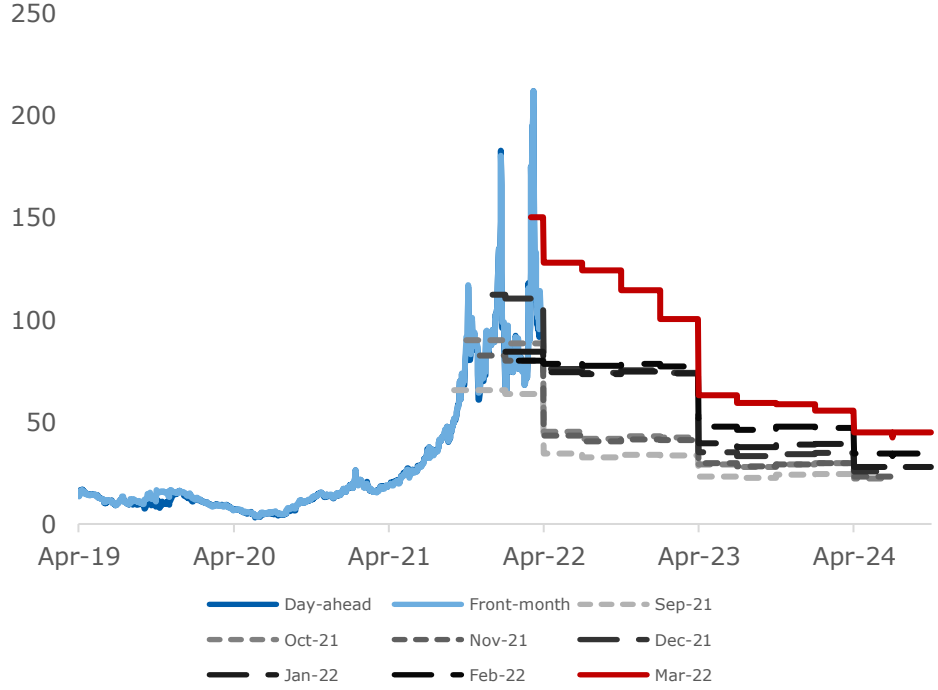
Forward gas curve inverts in March 2022

Germany baseload power, €/MWh



Argus TTF, €/MWh



Source: Argus European Electricity and European Natural Gas

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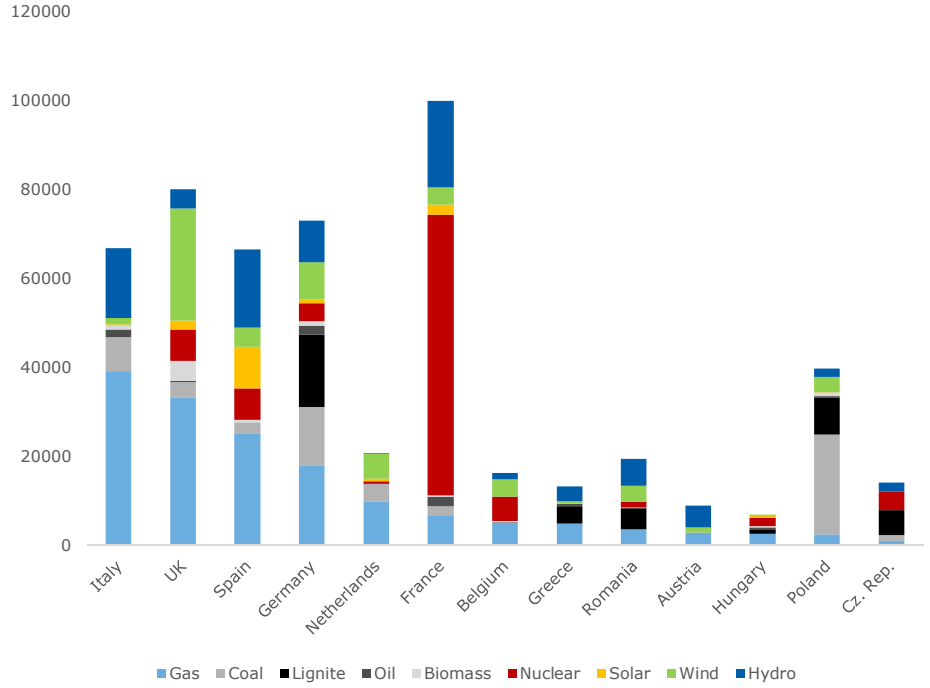
Generating stacks vary across Europe

European generating stacks*, sample MW installed



Source: Argus European Electricity (EER), operational plant database

Note: Sample of European economies' generating stacks

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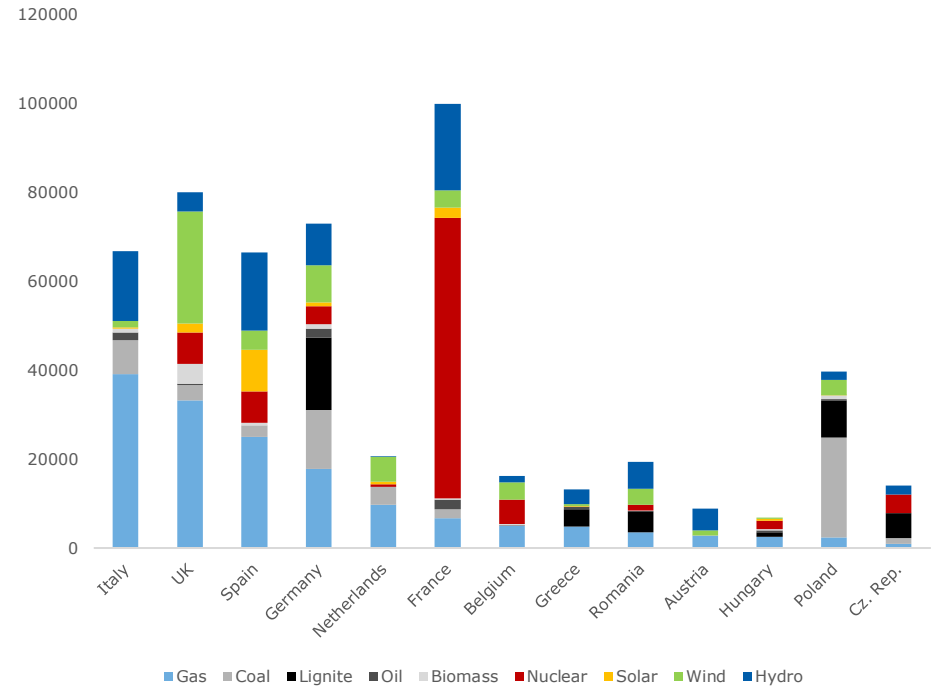
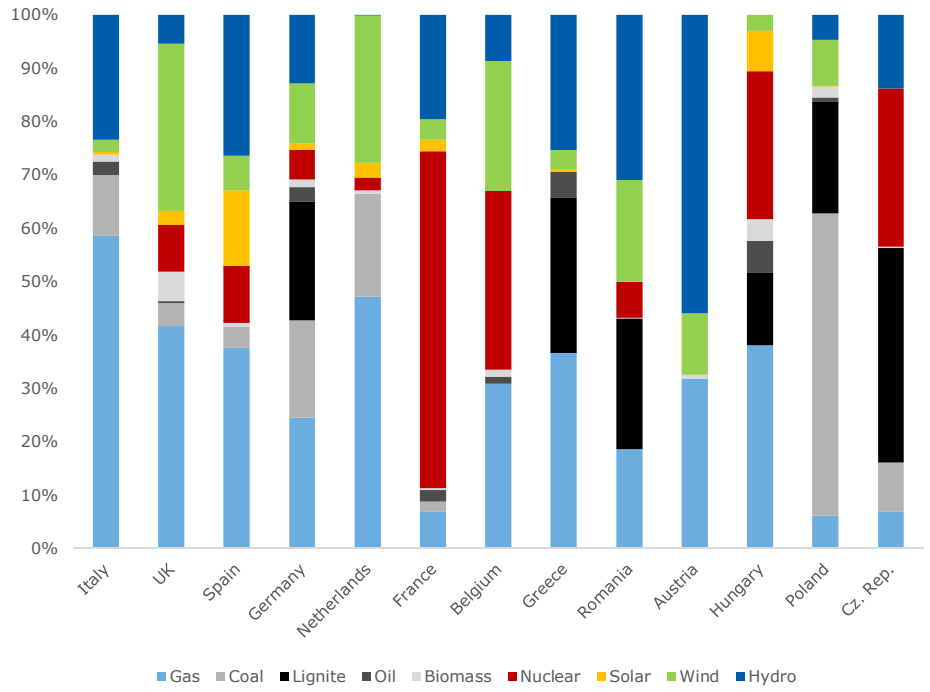
Thermal supply stack varies across Europe

European generating stacks*, sample MW installed



European generating stacks*, sample pc installed



Source: Argus European Electricity (EER), operational plant database

Note: Sample of European economies' generating stacks

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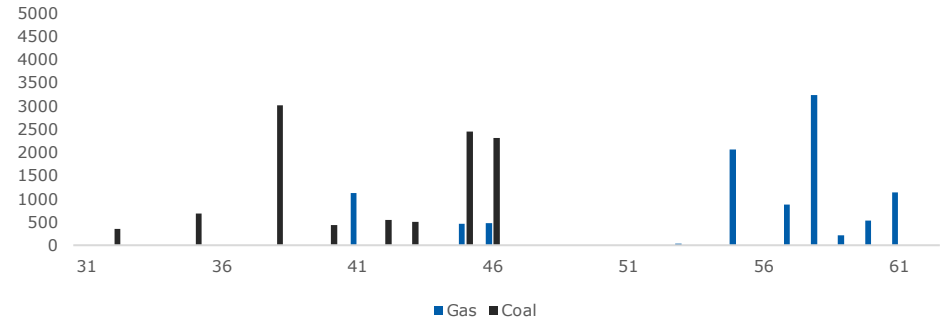
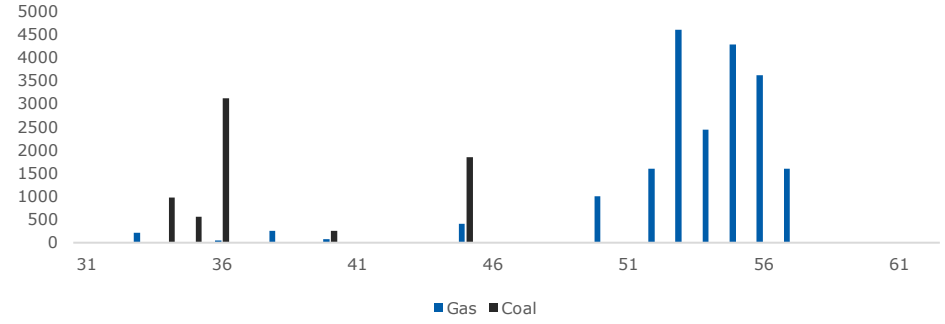
Germany and Italy thermal supply stack competition

Germany capacity and plant efficiency, MW and pc



Italy capacity & plant efficiency, MW & pc



Source: Argus European Electricity (EER), operational plant database

Note: Germany and Italy hard coal and gas-fired operational plant stacks and plant operating efficiencies

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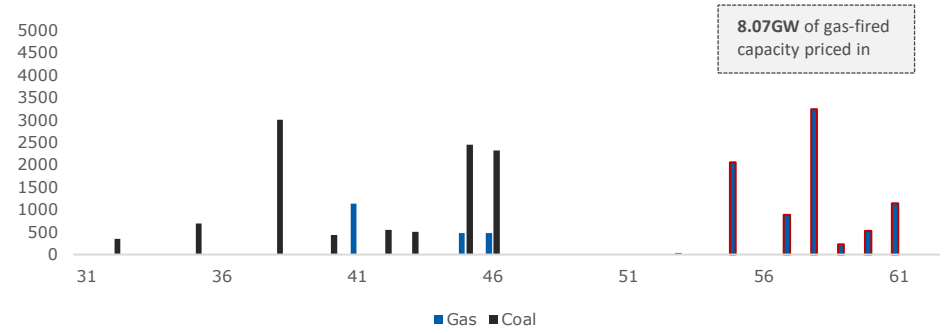
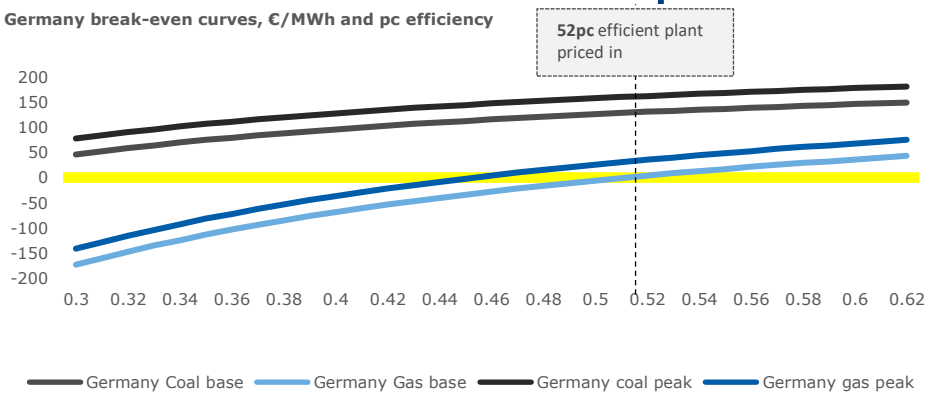
Gas plant could run this summer on baseload prices

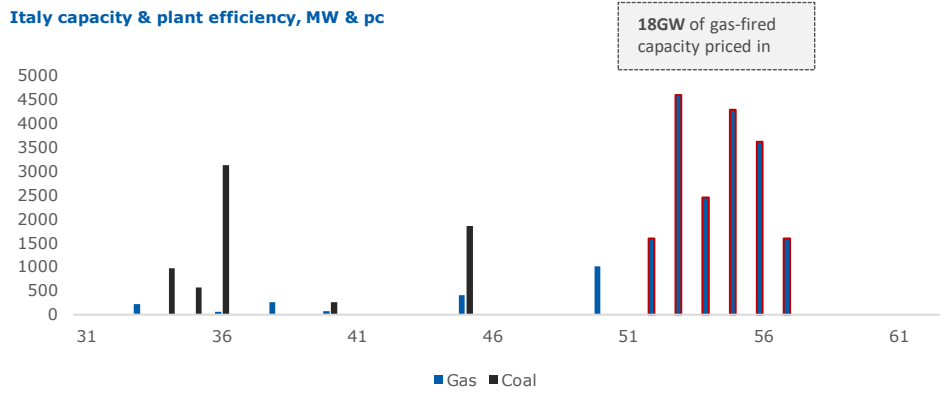
Germany capacity and plant efficiency, €/MWh



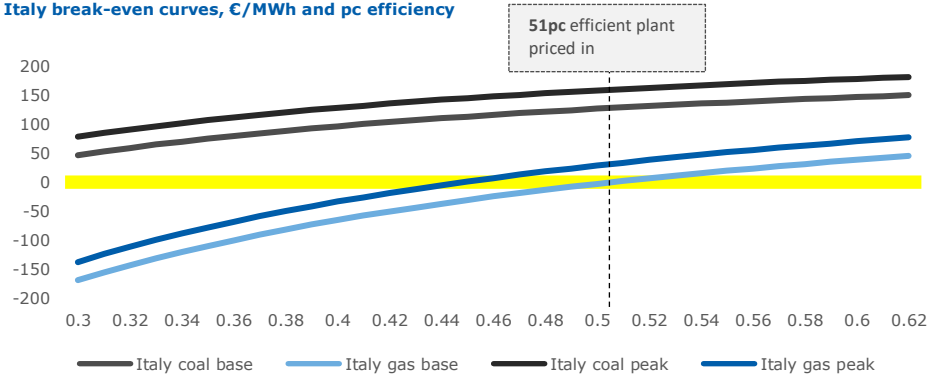
Germany break-even curves, €/MWh and pc efficiency



Italy capacity & plant efficiency, MW & pc



Italy break-even curves, €/MWh and pc efficiency



Source: Argus European Electricity (EER), operation

Note: Germany and Italy break-even curves as of 30th March 2022. The break even uses average gas (hub), coal (ARA), power (hubs) and emissions (EU ETS) prices during 1Q22

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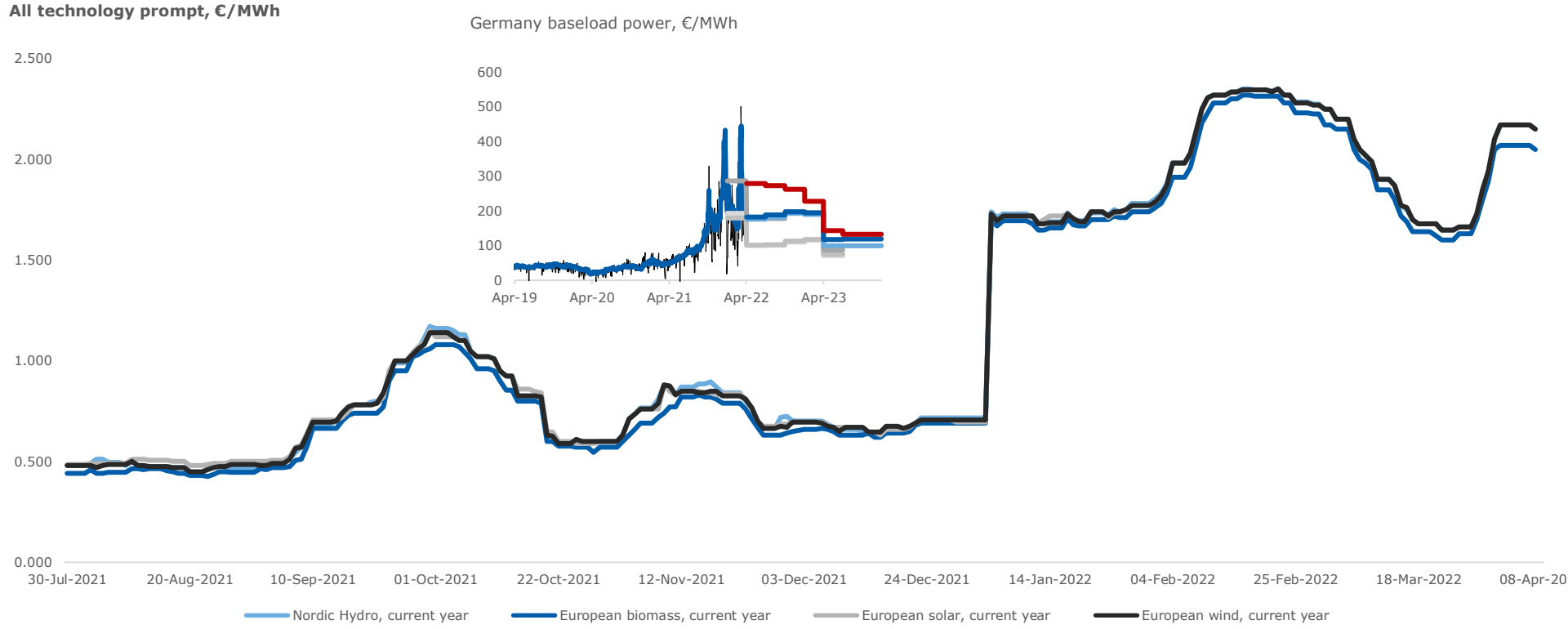
Current vintage technology spreads



Source: Argus European Electricity-published news and data (EER)

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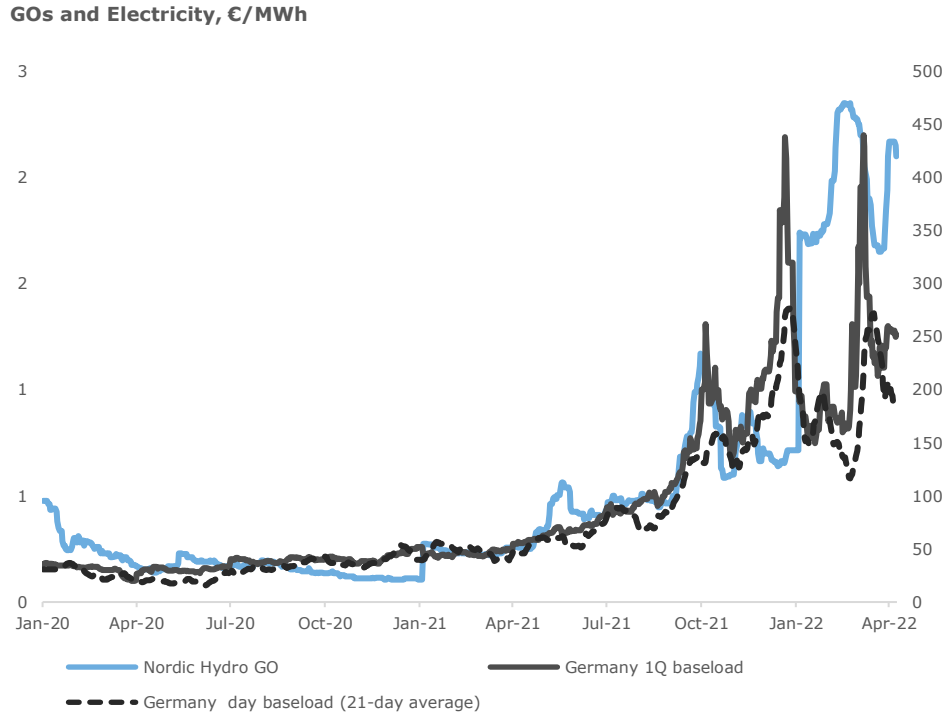
GO price as a proportion of green-backed supply mixed



Source: Argus European Electricity (EER), German generation by source database – Nordic Hydro current year vintage, Germany baseload OTC 1Q

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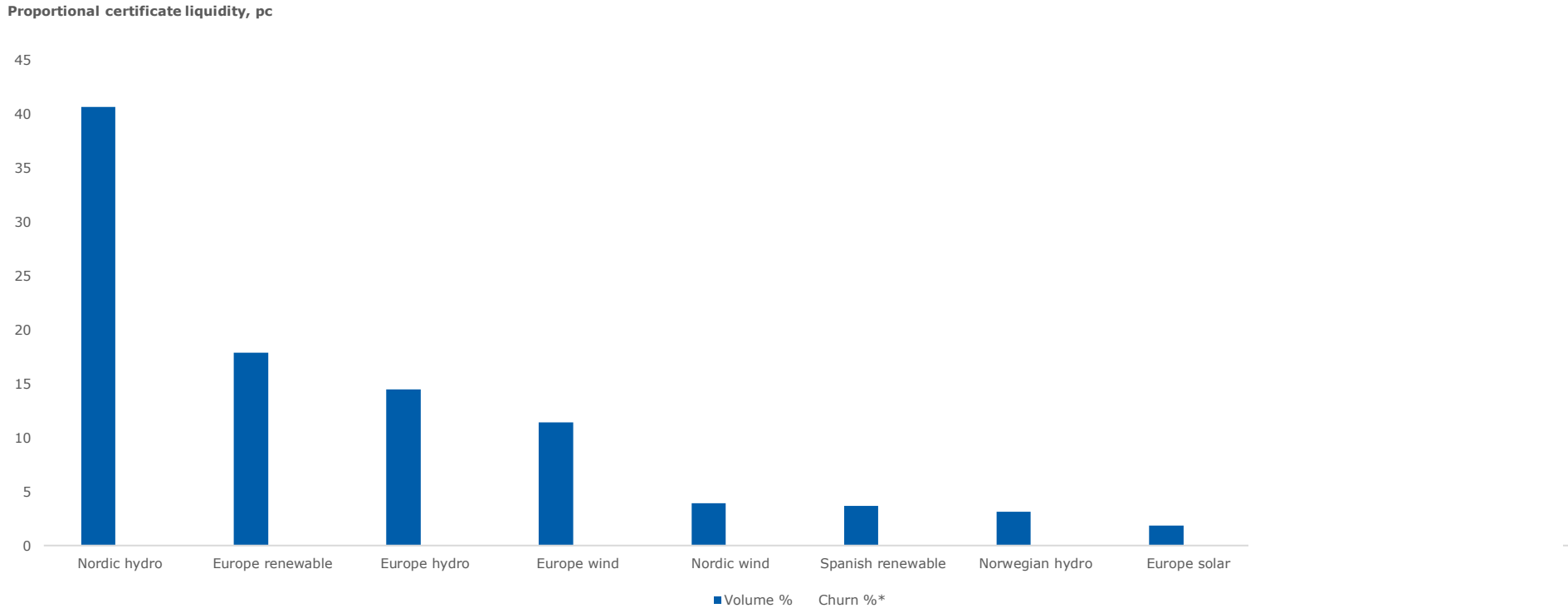
Winter 2021-22: Nordic hydro remains the most traded certificate by volume



Source: (EER) – representative market cross-section based on Argus research and data. Trade period – October 2021-March 2022

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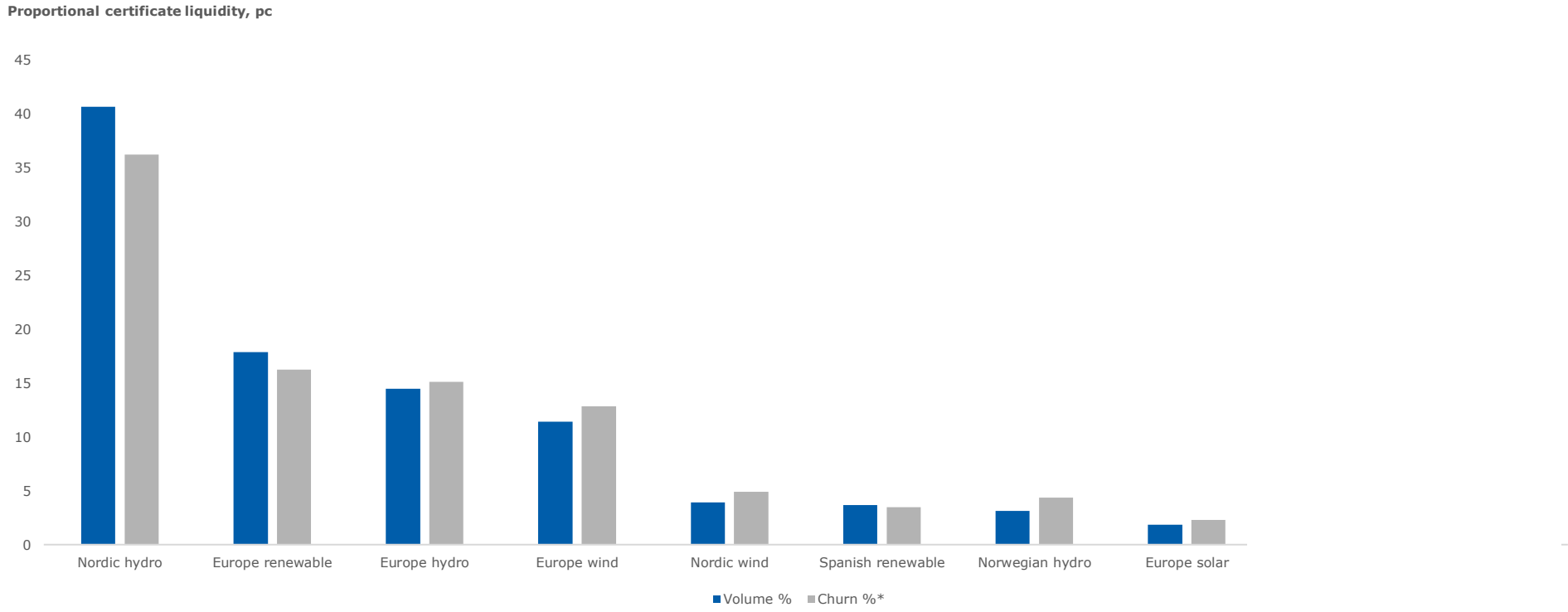
Winter 2021-22: trade number ratio higher for some Europe-level products



Source: (EER) – representative market cross-section based on Argus research and data. Trade period – October 2021-March 2022

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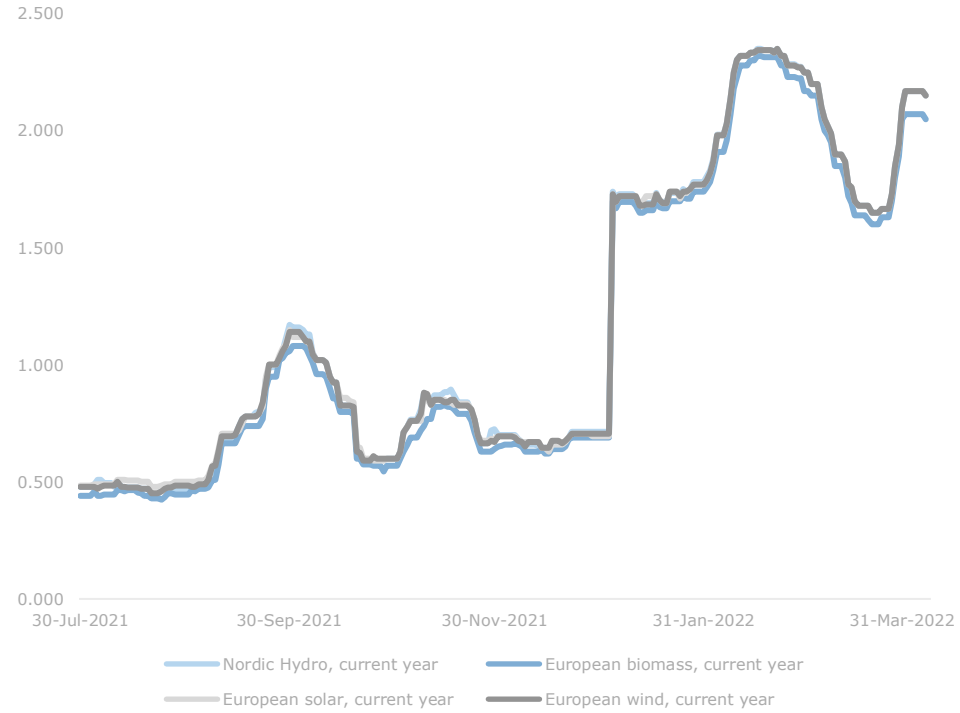
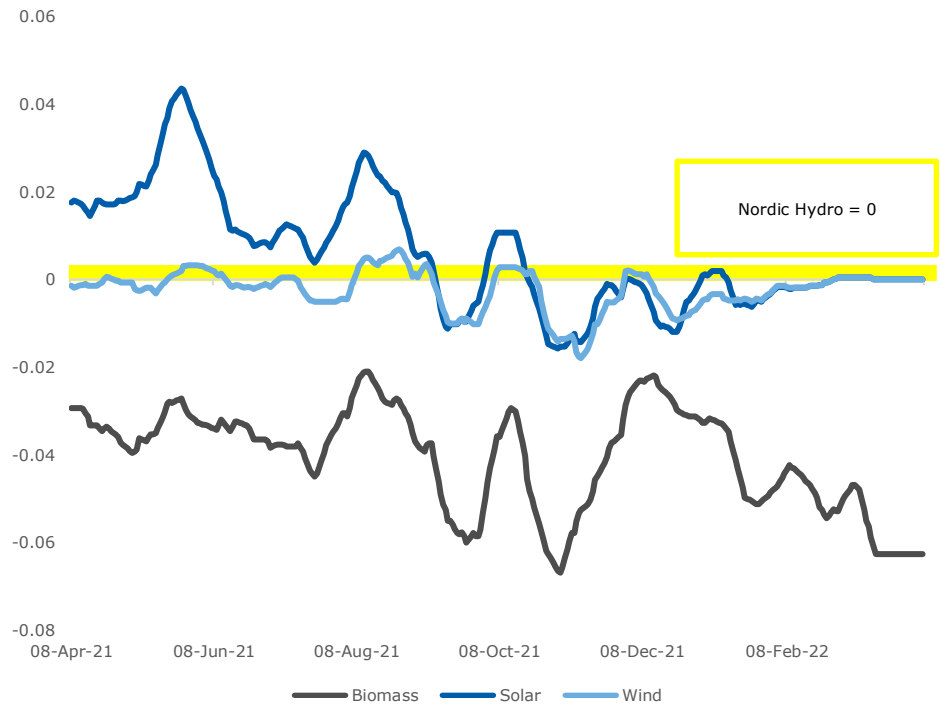
Current vintage technology spreads

All technology prompt, €/MWh



21-day moving average hydro tech basis, €/MWh



Source: Argus European Electricity-published news and data (EER)

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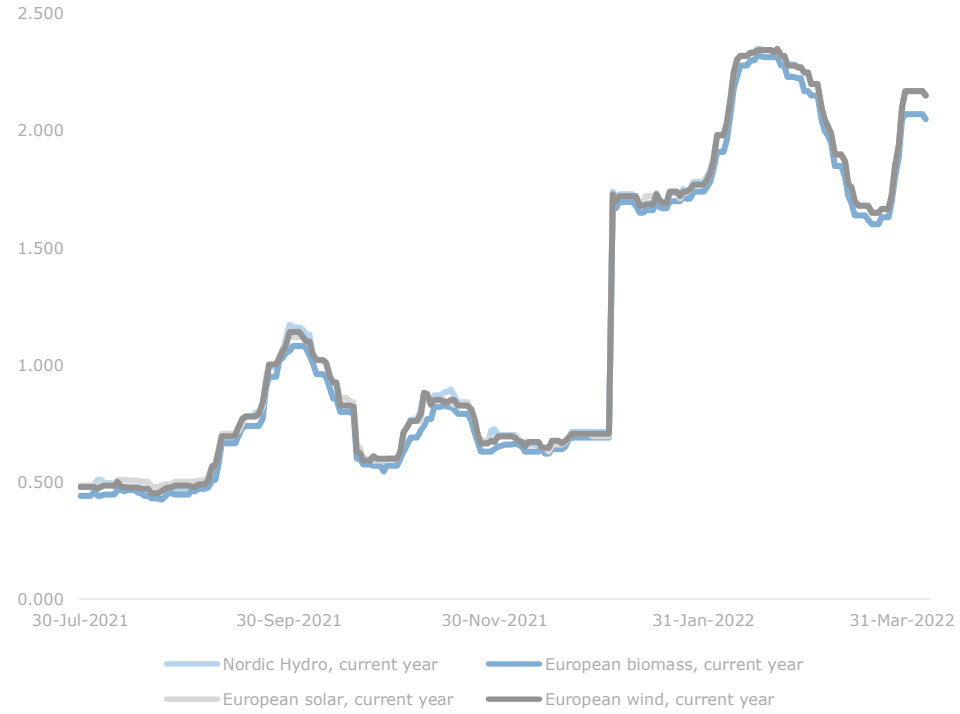
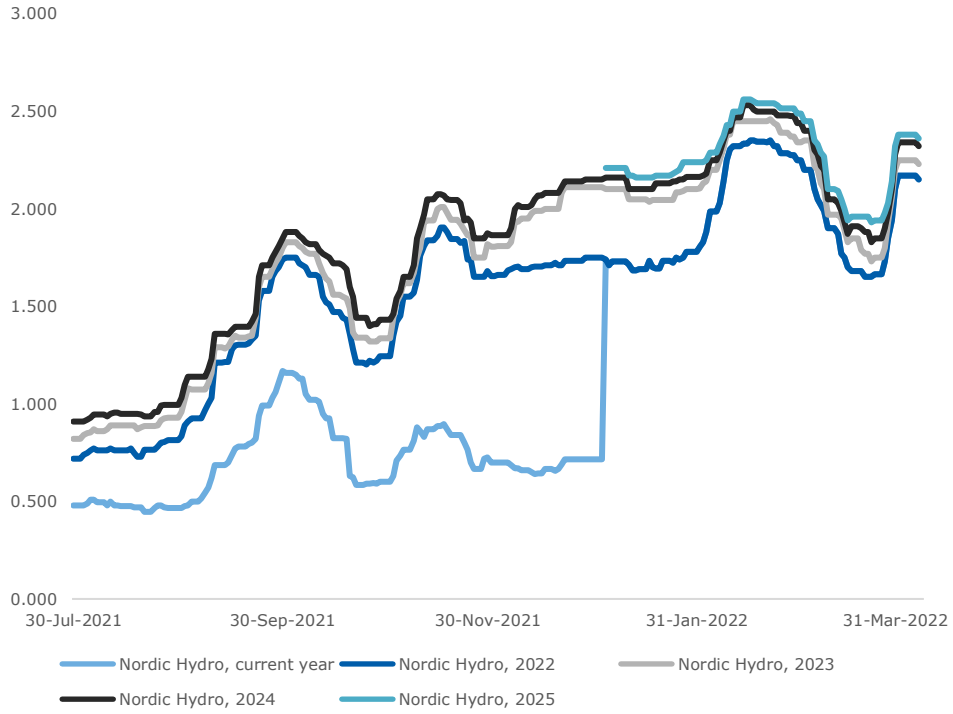
Forward curve in contango (current vintage discount)

All technology prompt, €/MWh



Nordic hydro, forward vintages €/MWh



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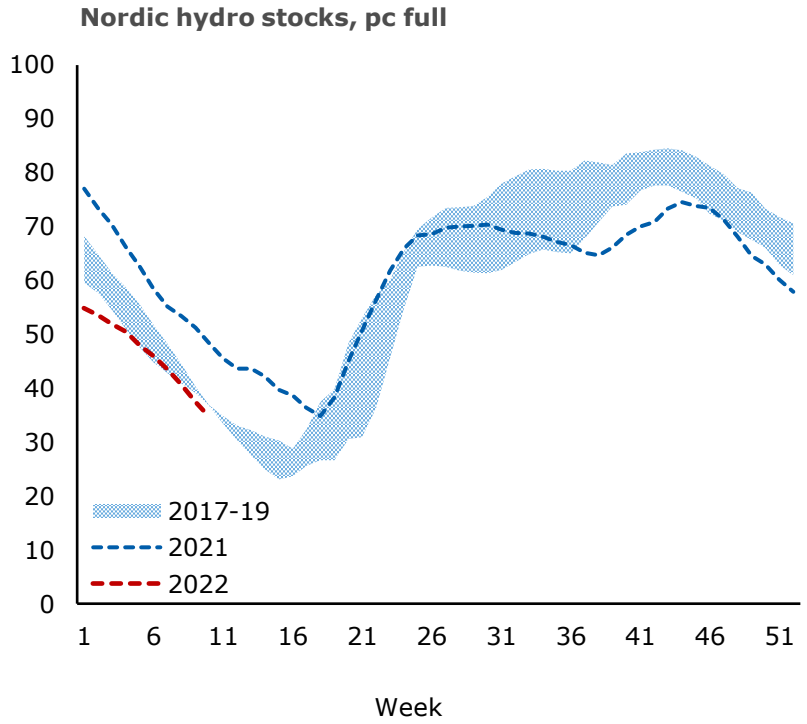
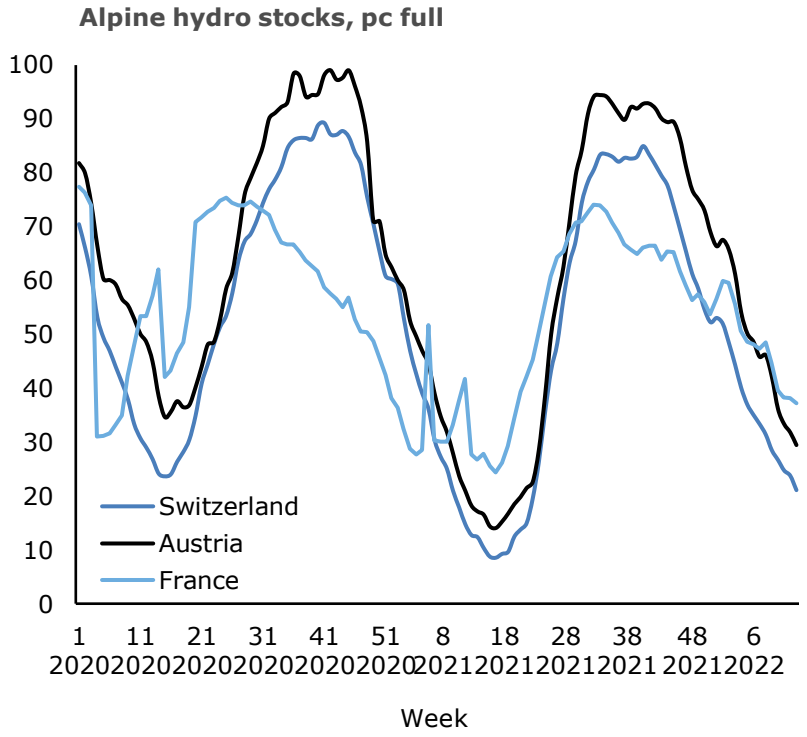
Nordic hydro stocks below average start 1Q22





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French scheduled nuclear availability weaker

France scheduled nuclear unavailability

2021	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
January	9.8	9.2	9.2	9.2	9.5	9.2	9.1	9.4	10.1	9.1	9.1	9.6	10.4	9.3	9.5	11.4	10.3	10.0	12.8	10.9	10.7	10.8	10.3	10.1	11.2	11.3	10.4	11.5	12.5	14.3	13.1
February	11.7	11.4	11.4	11.2	11.1	13.0	13.7	13.4	12.8	12.8	13.1	13.1	14.6	15.0	15.5	14.7	15.9	15.6	16.1	17.7	18.2	17.2	16.4	16.2	16.3	16.5	18.5	20.6			
March	20.7	20.0	18.5	17.9	18.3	17.4	16.4	16.4	16.8	16.8	15.8	15.3	17.1	16.3	15.5	14.9	14.9	14.9	15.1	17.1	17.3	17.1	16.1	15.7	15.9	16.2	19.3	19.7	19.5	19.0	19.5
April	19.5	18.9	20.0	21.5	22.3	21.5	21.6	23.1	21.9	23.1	23.0	22.6	22.7	22.5	21.7	22.0	24.4	24.2	23.3	22.0	22.0	21.9	21.9	22.4	22.2	21.9	22.2	21.5	21.3	21.7	
May	21.1	24.3	23.0	21.8	22.1	22.7	22.7	25.8	26.5	26.0	23.0	21.6	20.9	20.7	21.3	21.6	22.0	20.2	19.2	20.4	20.8	22.9	23.0	21.9	22.1	21.1	20.5	21.2	21.7	21.2	21.0
June	20.4	20.4	20.7	20.8	22.2	22.3	21.3	20.6	20.6	20.7	20.9	21.1	21.7	21.6	21.7	21.7	22.1	23.7	24.0	22.0	20.8	21.3	20.0	19.4	19.4	19.8	20.2	19.6	19.2	20.2	
July	21.6	21.7	21.9	23.8	20.9	20.2	19.8	20.1	22.3	25.9	25.0	23.5	22.1	20.6	21.2	20.8	21.3	21.2	19.9	19.6	19.6	20.1	18.5	20.8	20.4	17.9	17.9	17.0	16.9	16.7	18.2
August	18.7	19.0	19.4	19.8	20.3	21.7	21.7	23.0	21.4	21.4	21.8	21.6	22.3	22.3	21.2	19.2	18.0	17.7	17.6	18.2	19.7	19.0	17.8	18.0	18.1	18.0	18.0	18.7	18.6	17.0	16.6
September	15.6	15.8	16.4	18.7	18.7	17.2	16.3	16.4	17.3	18.7	20.7	19.3	18.2	19.1	18.6	17.6	19.2	22.7	22.3	20.3	18.5	19.2	20.1	20.8	22.5	21.4	21.0	20.8	19.9	19.6	
October	18.4	20.9	21.0	18.9	20.2	19.3	19.4	19.0	18.2	17.7	16.9	16.8	16.2	16.3	17.5	17.6	17.5	17.5	17.6	17.9	18.8	20.0	22.3	20.9	19.5	18.2	17.4	16.5	16.9	17.4	17.9
November	18.5	18.0	18.3	17.8	19.0	20.9	20.4	19.7	18.9	18.4	19.2	18.5	18.8	19.5	19.0	16.7	16.6	16.8	16.5	16.9	18.1	17.8	17.8	19.4	18.9	18.8	19.7	19.5	17.9	16.7	
December	17.7	18.4	19.0	20.1	20.3	18.6	18.5	18.5	18.2	18.0	18.1	18.5	17.9	18.0	17.2	16.3	17.6	17.1	17.4	17.8	18.0	17.0	17.1	17.9	17.3	16.3	15.9	15.7	16.6	18.2	18.9

2022	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
January	18.8	17.9	15.6	14.7	14.3	13.1	13.9	14.7	13.3	12.8	14.0	13.8	13.3	12.9	12.8	12.7	12.7	12.7	12.8	12.6	12.0	12.0	12.6	12.3	12.5	12.0	12.0	12.1	13.0	12.1	13.0
February	13.1	12.6	12.7	12.8	15.0	15.3	15.4	15.4	15.5	15.1	14.9	17.0	17.4	17.1	17.0	15.5	15.9	16.2	18.8	19.9	18.9	17.6	17.2	17.3	17.2	18.2	18.7	18.5			
March	18.2	18.4	18.5	18.2	18.2	18.6	18.9	18.7	18.2	21.0	21.1	24.5	24.9	25.4	25.3	24.9	24.5	24.4	25.1	24.0	22.9	22.9	24.0	24.0	24.4	27.6	27.6	27.6	27.5	26.7	26.7
April	26.7	27.5	27.4	26.7	26.7	26.7	26.7	26.8	28.3	28.2	26.8	26.7	26.7	26.7	26.7	27.6	27.6	26.7	26.7	27.2	26.9	26.9	26.8	25.6	25.6	25.6	26.0	26.5	26.4	26.1	
May	25.2	25.2	25.2	25.2	25.2	25.1	25.2	25.2	25.2	25.2	25.2	25.2	25.4	27.4	26.0	24.8	24.8	24.8	24.8	25.0	27.0	27.0	27.0	27.0	27.0	27.0	26.1	26.1	26.1	26.1	25.9
June	24.8	24.8	24.8	24.8	24.8	24.8	24.8	24.8	24.8	24.8	26.1	26.1	26.1	26.1	26.1	26.1	26.1	27.0	26.9	26.1	26.1	26.1	25.2	25.2	25.2	25.1	24.3	24.3	24.1	23.0	
July	22.9	23.6	23.0	23.0	23.0	23.0	23.0	22.9	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	22.5
August	22.5	22.5	22.5	21.6	21.7	22.4	21.6	21.6	21.6	21.6	20.7	20.8	23.8	23.8	23.8	22.5	22.5	22.5	22.5	23.8	23.8	23.8	23.8	23.8	23.8	23.8	23.8	23.8	22.9	22.0	21.8
September	20.5	20.5	20.4	19.2	19.2	19.2	17.9	17.9	18.0	19.7	19.7	19.7	19.7	18.4	18.4	18.4	19.3	19.3	19.3	19.3	19.3	18.4	18.4	19.3	18.4	18.4	18.4	18.3	17.5	17.4	
October	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	18.0	17.5	17.5	17.5	17.5	16.1	16.1	17.0	17.0	17.0	17.0	17.0	17.0	17.0	18.3	17.5	17.3
November	16.1	16.1	16.1	16.1	17.0	17.0	17.0	17.0	16.2	16.1	16.1	16.1	16.1	16.1	16.1	14.9	14.8	14.8	14.8	13.9	13.9	13.9	12.6	11.7	11.7	11.7	11.7	11.7	11.7	11.7	
December	10.8	10.8	10.8	10.8	10.8	10.8	10.8	9.5	9.4	9.4	8.2	8.1	8.1	8.1	7.3	7.2	7.2	7.2	7.2	6.4	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.1

Plant	Fuel	Average reduction over period
CIVAUX 2	NUCLEAR	982
CHOOZ 2	NUCLEAR	962
GOLFECH 2	NUCLEAR	819
CATTENOM 3	NUCLEAR	795
PALUEL 1	NUCLEAR	719
DAMPIERRE 1	NUCLEAR	669
FLAMANVILLE 1	NUCLEAR	588
CIVAUX 1	NUCLEAR	565
TRICASTIN 2	NUCLEAR	457
GRAVELINES 4	NUCLEAR	452
CHOOZ 1	NUCLEAR	445
BUGEY 4	NUCLEAR	445
CRUAS 1	NUCLEAR	420
ST LAURENT 1	NUCLEAR	418
BUGEY 5	NUCLEAR	415
PALUEL 2	NUCLEAR	411
CATTENOM 1	NUCLEAR	399
CATTENOM 2	NUCLEAR	383
PENLY 1	NUCLEAR	364
GRAVELINES 2	NUCLEAR	363
GRAVELINES 1	NUCLEAR	363
ST LAURENT 2	NUCLEAR	344
BELLEVILLE 2	NUCLEAR	320
PALUEL 3	NUCLEAR	317
GRAVELINES 6	NUCLEAR	315
DAMPIERRE 3	NUCLEAR	300
BLAYAIS 2	NUCLEAR	299
CRUAS 2	NUCLEAR	299
CHINON 3	NUCLEAR	296
CHINON 2	NUCLEAR	293

Plant	Fuel	Average reduction over period
CHOOZ 2	NUCLEAR	1,500
CHOOZ 1	NUCLEAR	1,500
CIVAUX 2	NUCLEAR	1,495
PENLY 1	NUCLEAR	1,107
CIVAUX 1	NUCLEAR	995
FLAMANVILLE 1	NUCLEAR	974
GOLFECH 1	NUCLEAR	643
PALUEL 2	NUCLEAR	561
ST LAURENT 2	NUCLEAR	513
GRAVELINES 3	NUCLEAR	506
DAMPIERRE 2	NUCLEAR	498
BLAYAIS 1	NUCLEAR	463
CHINON 3	NUCLEAR	463
TRICASTIN 3	NUCLEAR	435
CATTENOM 4	NUCLEAR	400
NOGENT 1	NUCLEAR	380
ST ALBAN 2	NUCLEAR	377
FLAMANVILLE 2	NUCLEAR	356
PENLY 2	NUCLEAR	353
PALUEL 4	NUCLEAR	350
BELLEVILLE 2	NUCLEAR	348
CATTENOM 1	NUCLEAR	339
CATTENOM 3	NUCLEAR	294
BUGEY 4	NUCLEAR	260
BUGEY 3	NUCLEAR	259
TRICASTIN 4	NUCLEAR	255
GRAVELINES 5	NUCLEAR	249
GRAVELINES 4	NUCLEAR	242
CRUAS 4	NUCLEAR	241
CHINON 4	NUCLEAR	232

Source: Argus European Electricity-published data (EER)

Note: NA

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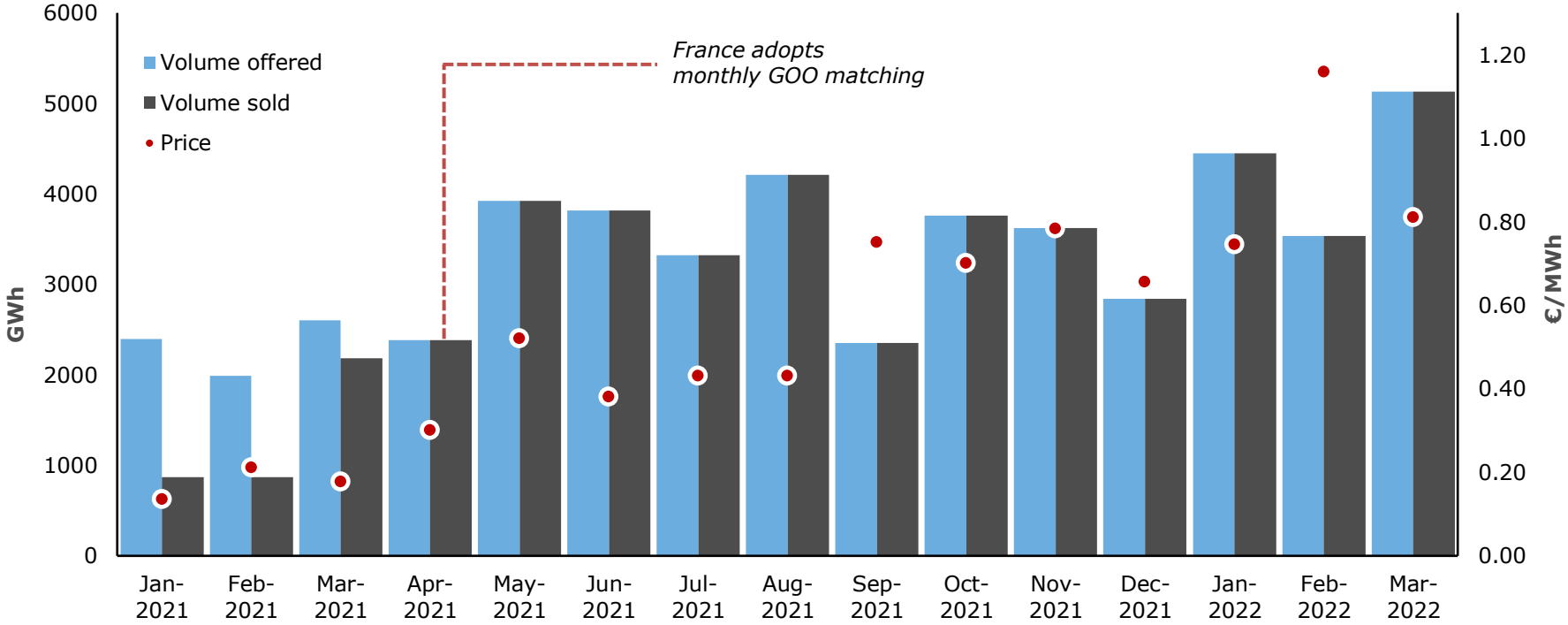
GOO price drivers – French auctions spur demand

French GO auctions (monthly), GWh/ €/MWh



Source: Argus European Electricity-published data (EER)

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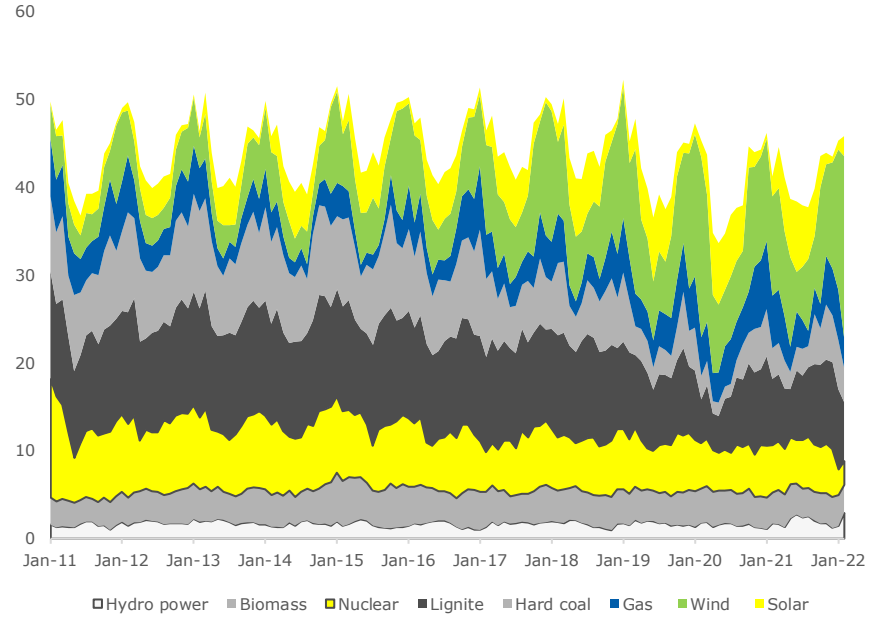
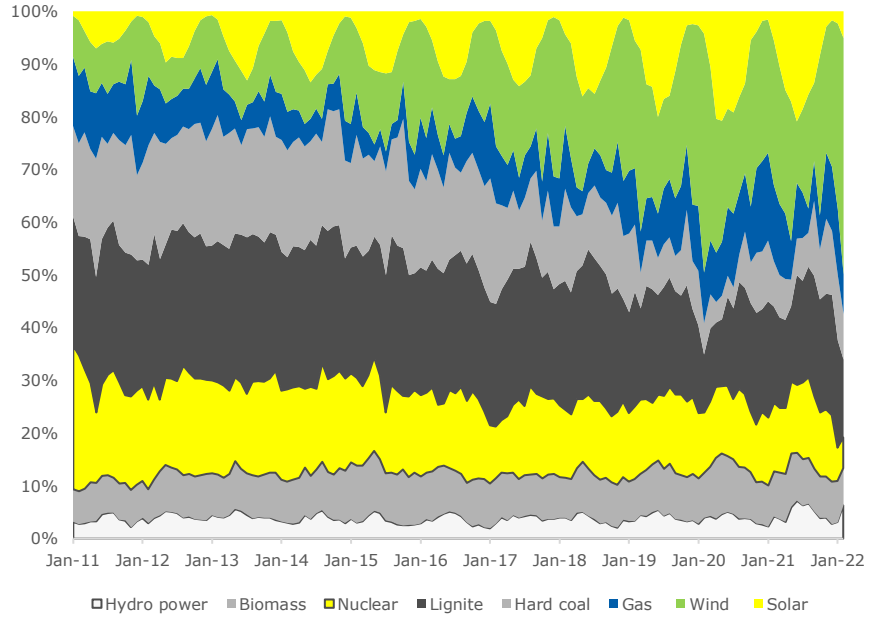
German electricity generation pivots to renewables

German electricity generation, TWh/m



German electricity generation, proportional (pc)



Source: Argus European Electricity (EER), German generation by source database

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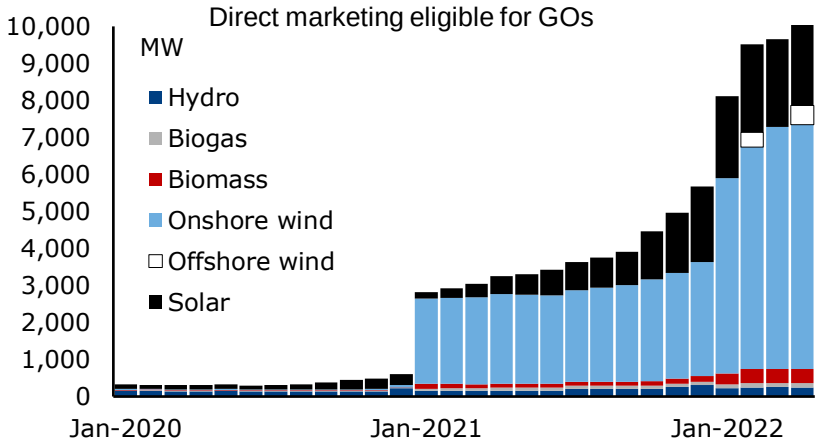
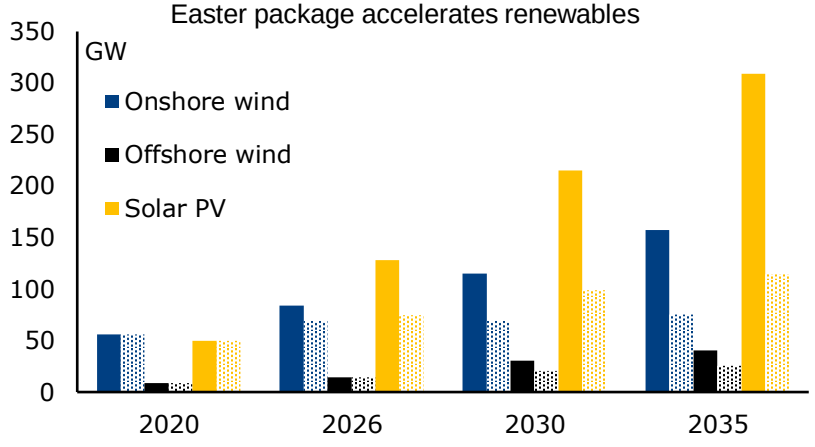
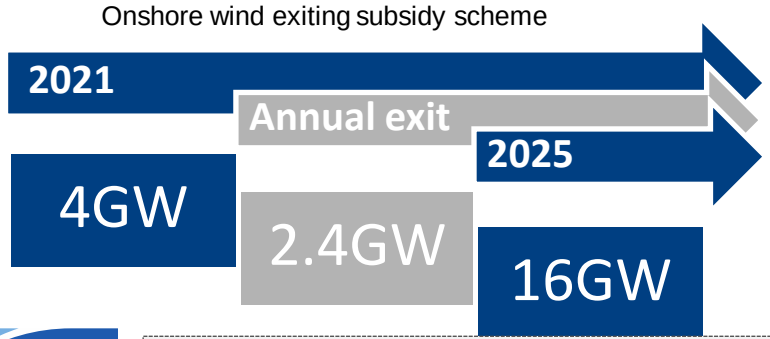
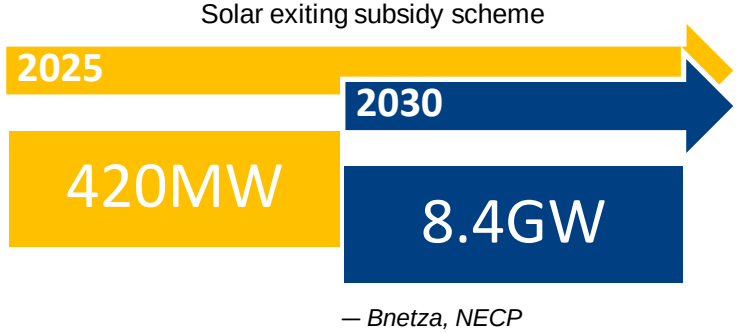
Germany — swapping subsidies for certificates









— Bnetza, NECP

Source: Argus European Electricity (EER)

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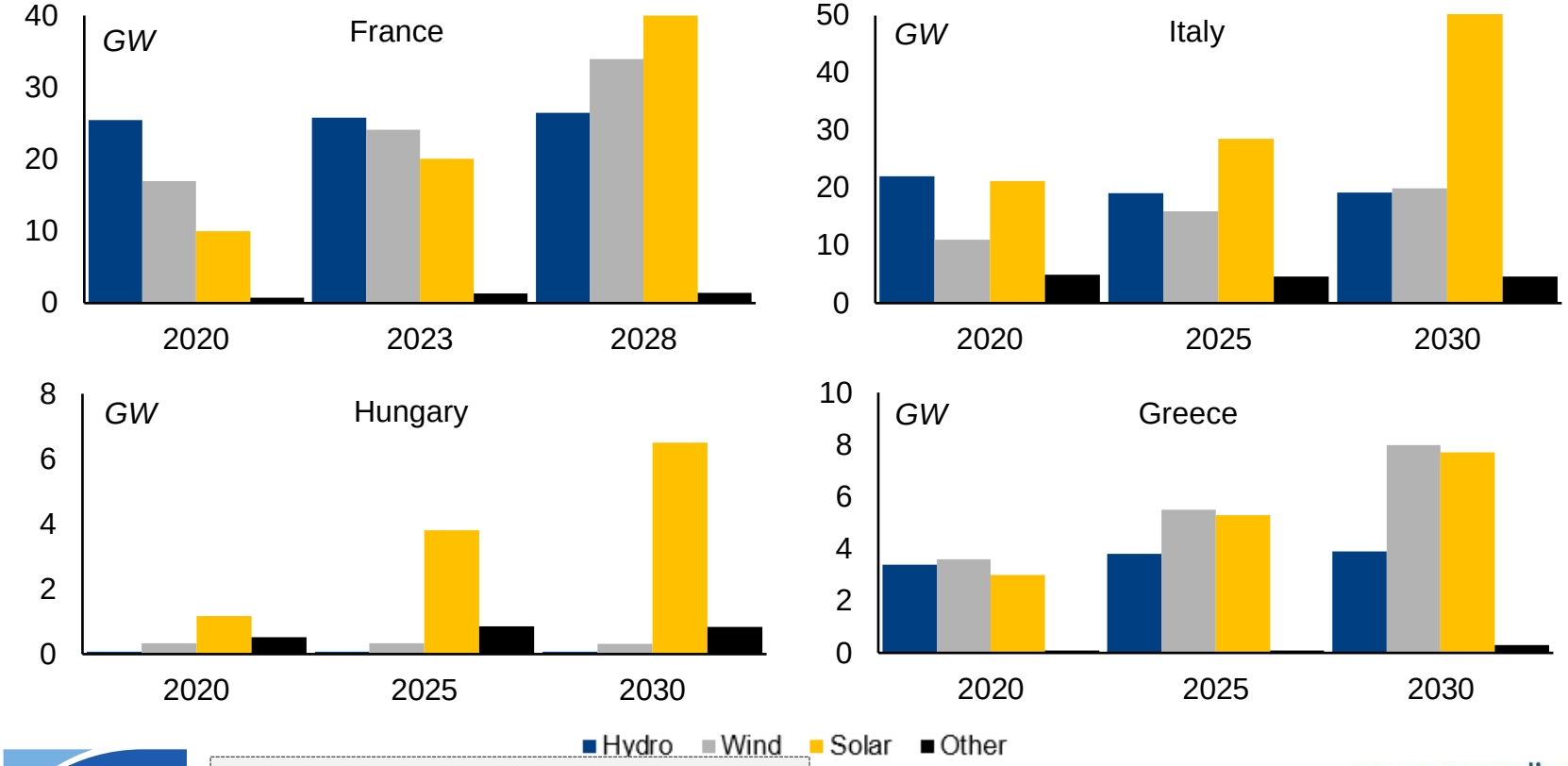
Renewable capacity projections



Source: NECPs, reported in Argus European Electricity (EER)

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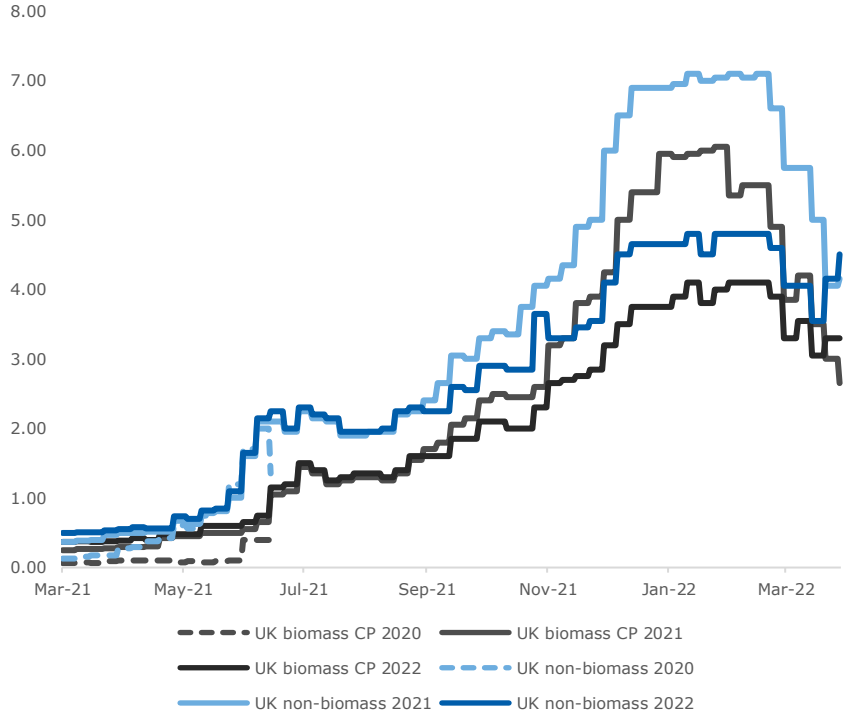
UK Regos — high prices, regulatory uncertainty

UK REGO prices, £/MWh



GOOs imported in 2019/20

Total 7.5TWh

Regos exported in 2019/20

Total 58TWh

Source: Reported in Argus European Electricity (EER)

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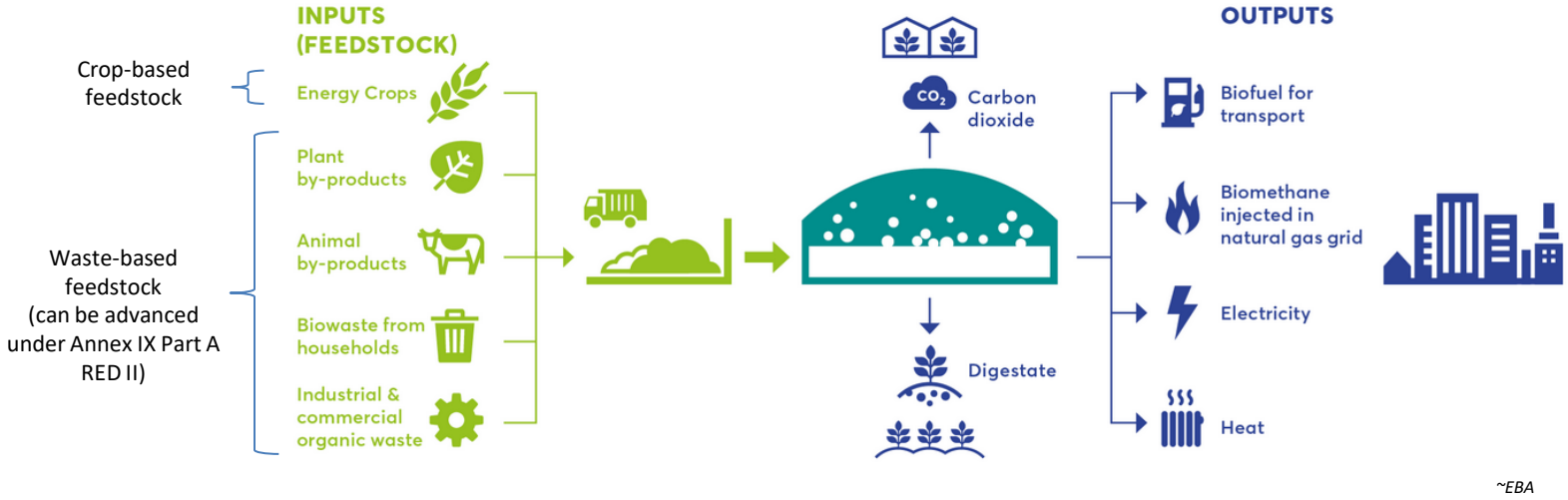
Turning to biomethane technologies



Yield of biogas depends on

- Energy content of the feedstock
- Length of time in digester
- The type of plant and conditions in the digester
- The purity of the feedstock

Clear trend towards agricultural residues, bio- and municipal waste and sewage sludge in Europe

Source: Graphic, European Biogas Association (EBA).

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Biomethane support schemes – European patchwork

EU member states and others implement schemes for biomethane based on the following broad criteria*

Feed-in-tariffs [FiTs]	A technology specific support scheme providing technology specific remuneration per unit of renewable energy. These are determined by public authorities
Feed-in premium [FiP]	Bonuses paid above the prevailing, pre-specified benchmark price. Constitutes a technology-specific subsidy per unit of renewable energy.
Green quota/ certification [GC]	Obligatory targets are set for a given sector of the economy to consume a given volume of technology-backed/ green energy supply. Renewables certificates are tracked by a competent authority
Fiscal incentives	Renewable energy generators receive tax incentives/ exemptions to compensate for the increased cost burden of supporting a given technology- or/ green-backed production
Investment support	Fixed amount of money received on development or completion of a technology- or green-backed project

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These schemes are defined fully in REGATRACE reporting, available here (downloads pdf).
This page is Argus' summary

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Demand segments for gas [methane] *per se*

There are a number of demand segments which currently use or could use biomethane for emissions abatement

Potential for grid blending or on site production (biogas) and delivery in the case of CNG, or blending and tank delivery on the case of LNG. Trucking and shipping	**Transport**
Potential for grid blending or on site production (biogas) and delivery for existing natural gas customers [biomethane], district heating	**Space heating and district heating**
Possible grid blending or on site production (biogas) and plant delivery, alternatively off-grid delivery and generation	**Electricity generation and district heating**
Energy intensive processes such as glass, steel, ceramics and paper manufacturing may not be able to fully electrify. Grid blending or on site production (biogas) and delivery may be an option	**Energy intensive industry**

Notes: Based on industry engagement

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A couple of definitions to begin

Biogas

Methane-rich gas produced from a crop or waste product

Biomethane

Methane-rich gas produced from a crop or waste product that has been modified for grid blending and injected into a natural gas TS/ DS

Notes: NA

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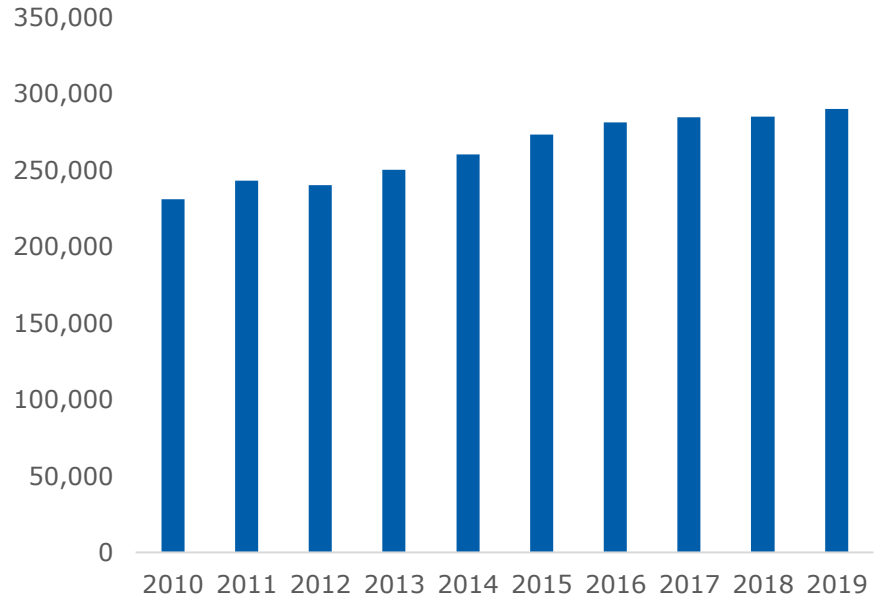
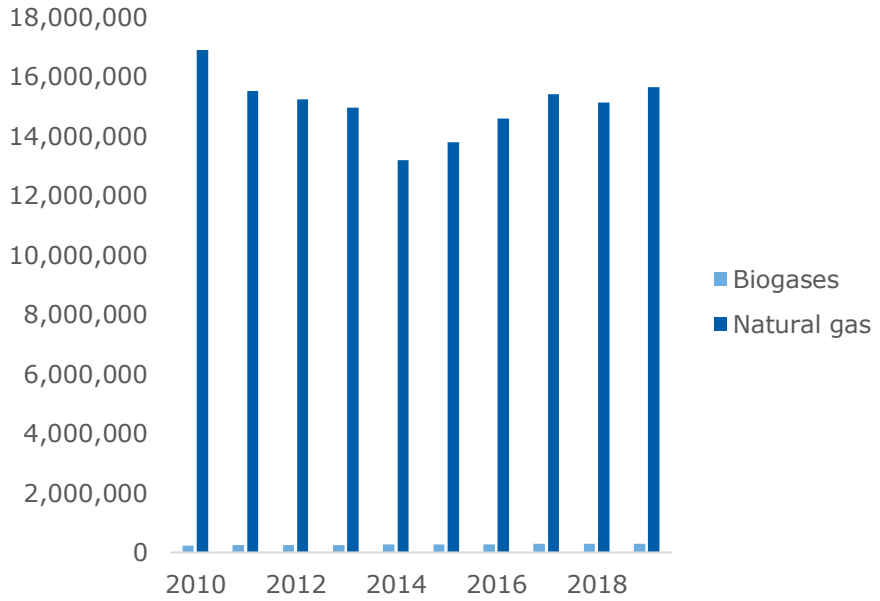
Biogases production versus natgas consumption

European biogases implied production*, Tj



European natgas, biogases consumption, Tj



Source: Eurostat

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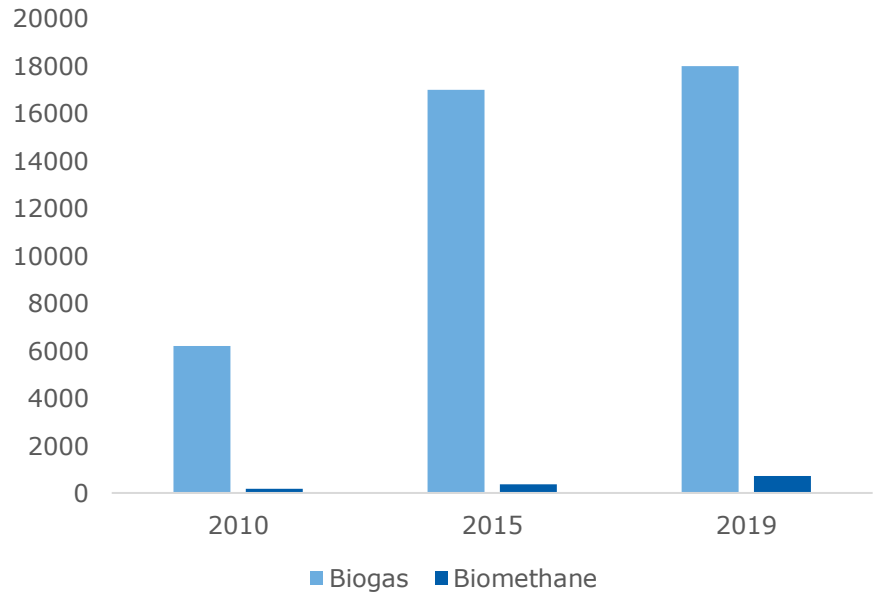
European biogases: much is not mobile

Biogas, biomethane plant*, number



Existing plant production capacity*
18bn m³ of biogas production capacity
~3bn m³ of biomethane production capacity

Source: *EBA & **various studies – Eurogas, IEA, Gas for Climate

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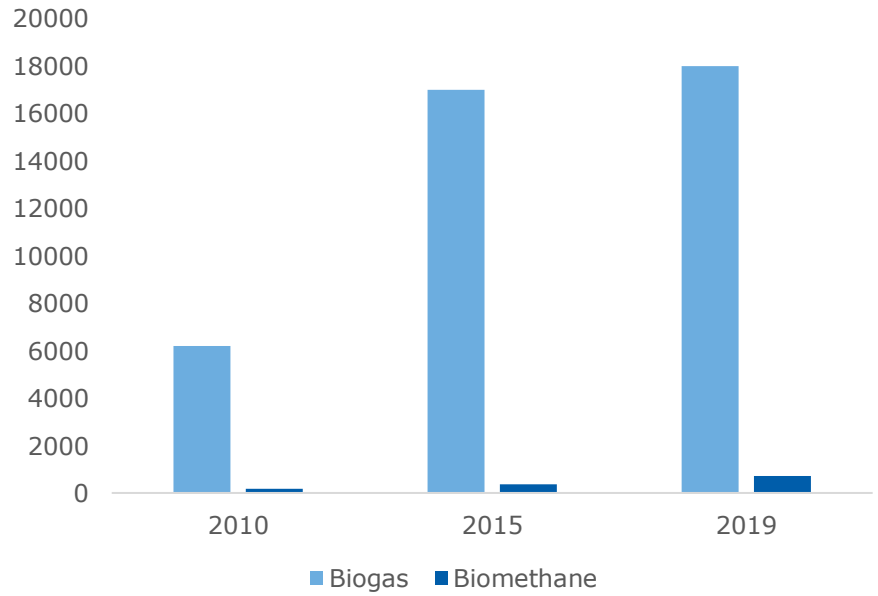
Current plant buildout – biogas, biomethane

Biogas, biomethane plant*, number



Existing plant production capacity*
18bn m³ of biogas production capacity
~3bn m³ of biomethane production capacity

Buildout projections [totals]**
2030: 35-44bn m³ of production capacity
2050: 95-125bn m³ of production capacity

Source: *EBA & **various studies – Eurogas, IEA, Gas for Climate

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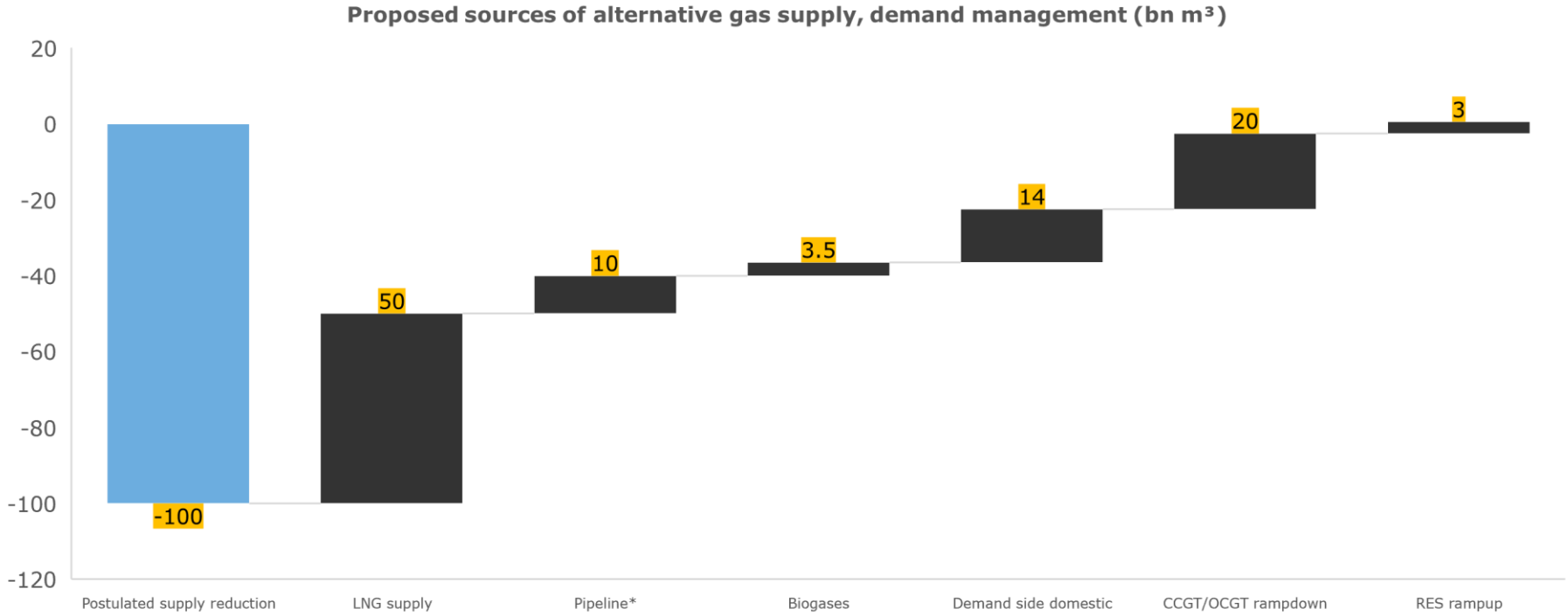
RePower Europe package proposes more biomethane



Source: Argus media analysis, ENG

Note: NA

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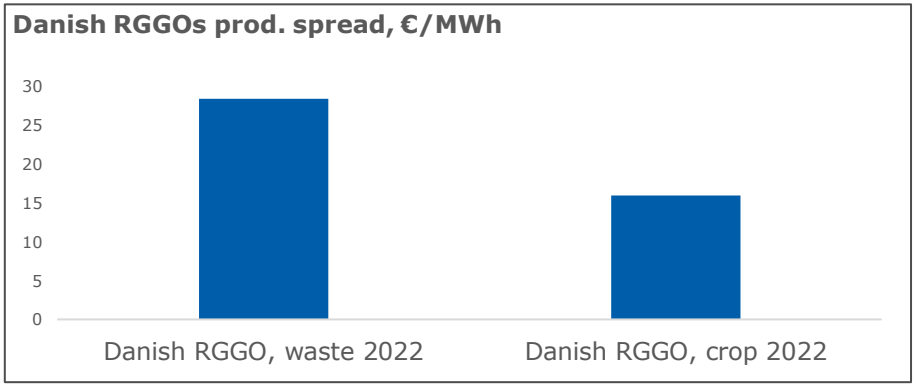
Waste-backed supply favoured in voluntary market



Source: Argus European Natural Gas and Biofuels reporting, further information is available here

Note: NA

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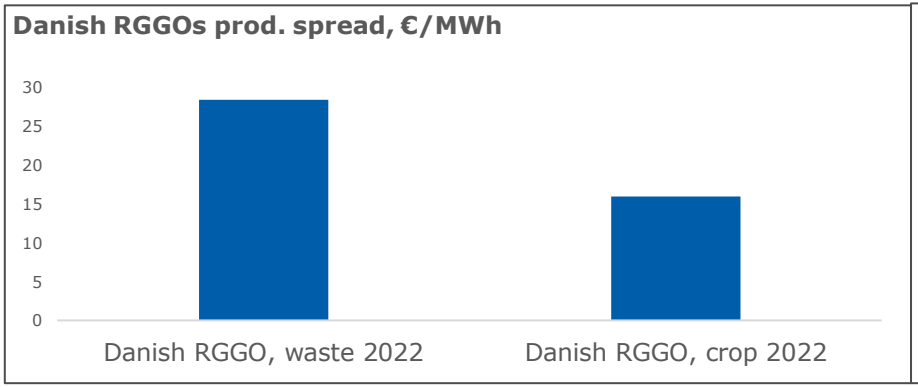
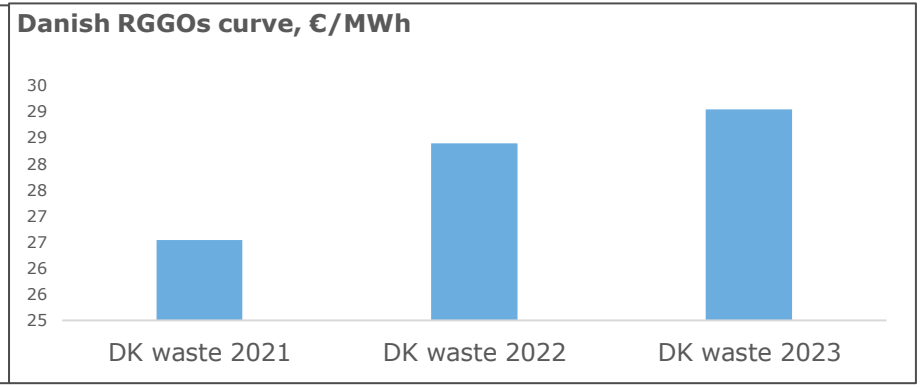
Future vintages at premium to 2022





Source: Argus European Natural Gas and Biofuels reporting, further information is available here

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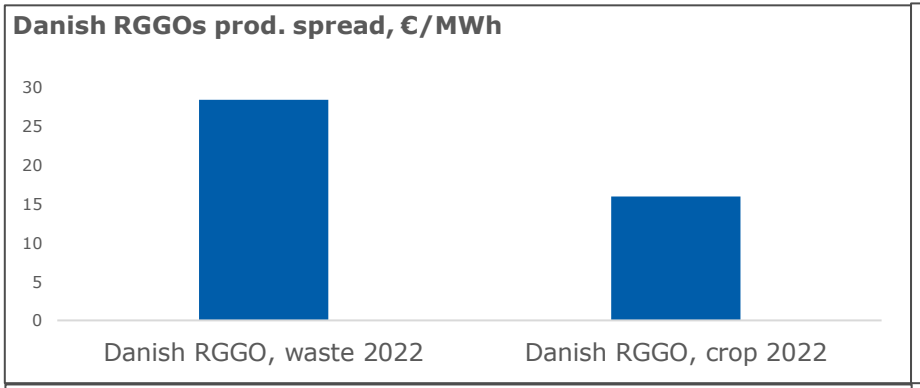
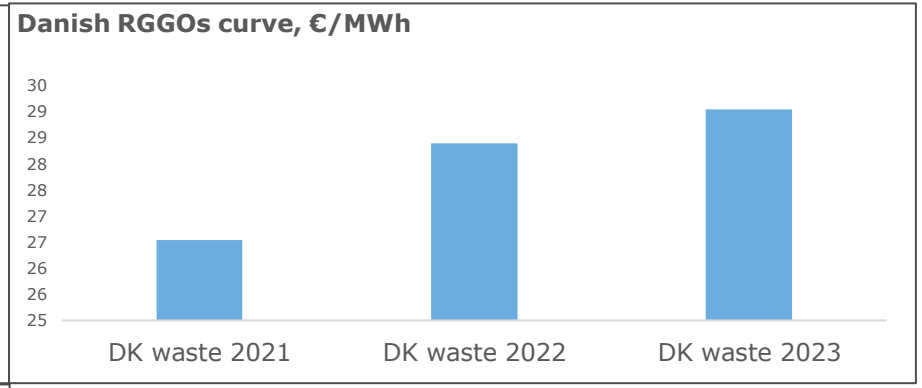
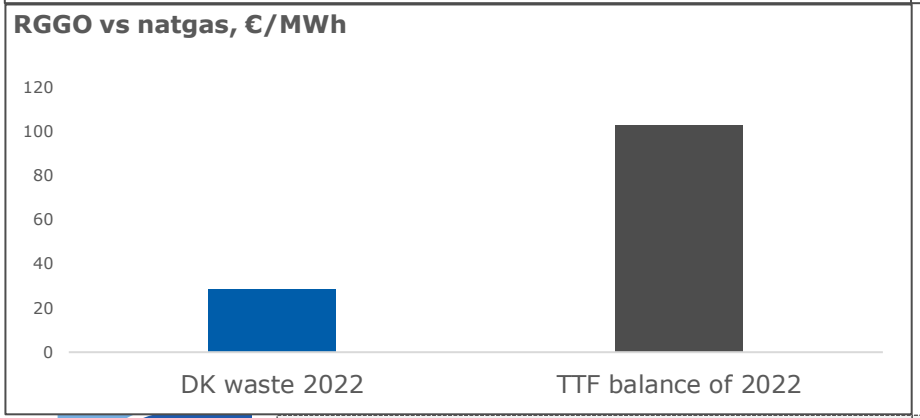
Gas RGGOs trading at <25pc of the energy supply cost







Source: Argus European Natural Gas and Biofuels reporting, further information is available here

Note: NA

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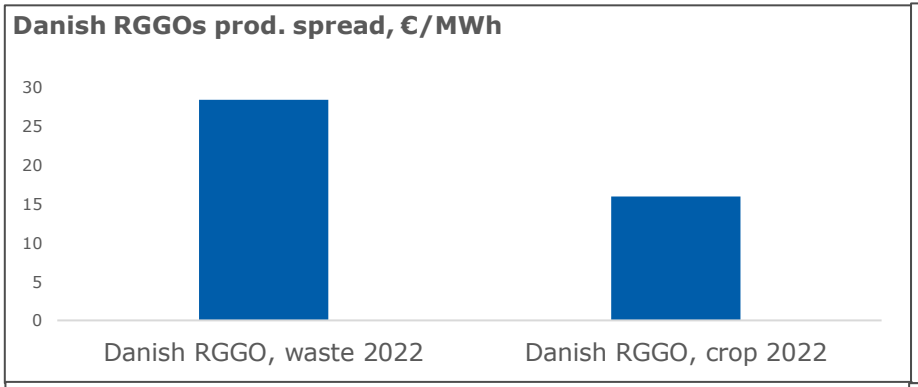
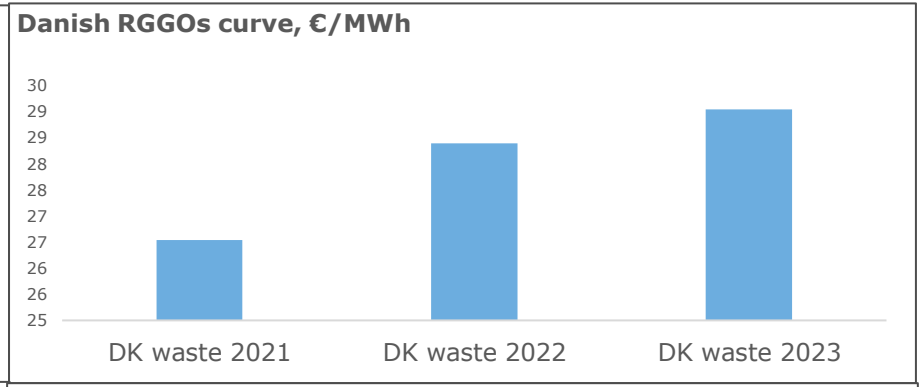
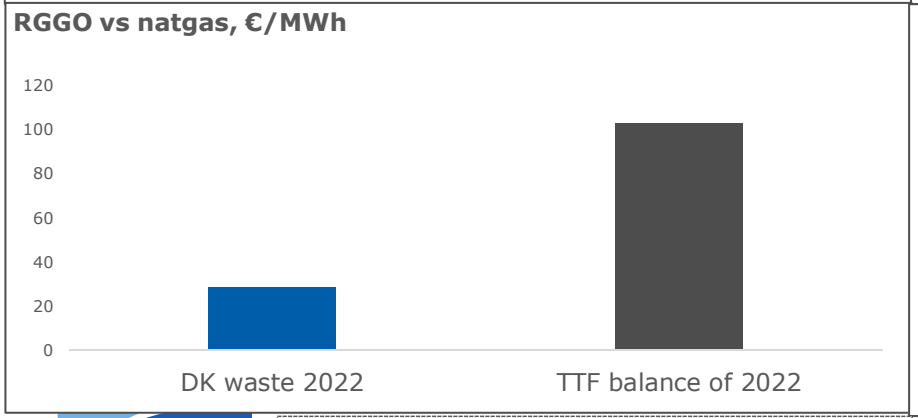
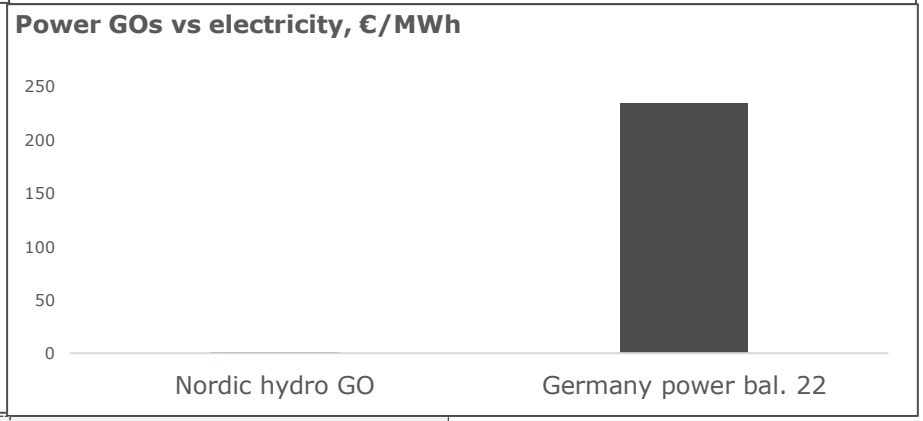
Power GOs trading at <1pc of the energy supply cost









Source: Argus European Natural Gas and Biofuels reporting, further information is available here

Note: NA

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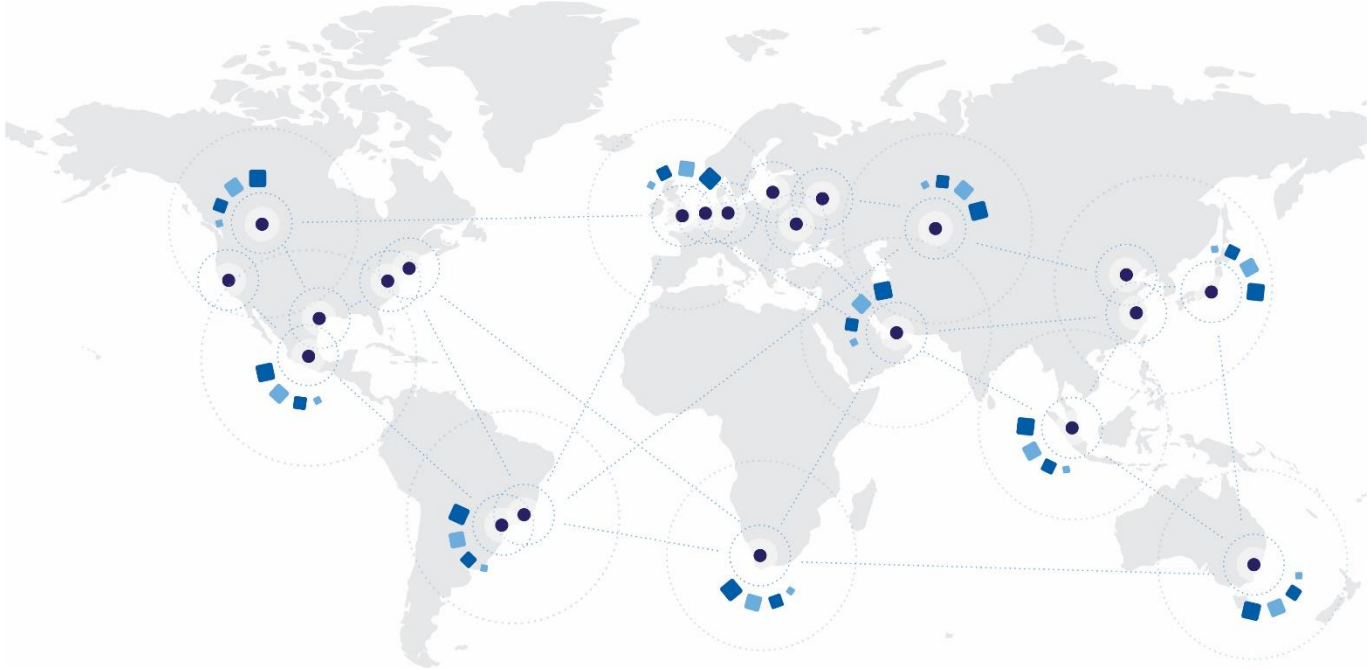

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Lawrence Templeton

VP European Natural Gas and Electricity

Lawrence.templeton@argusmedia.com
London
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