Net Zero risks in the context of the climate risks we are trying to avoid

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Overview

1. What are the (cascading) climate risks we are trying to avoid?
2. Net Zero: the scaling risks of BECCS
3. Risk minimisation: demand side offers a climate crisis - Russia crisis win-win
4. Conclusions

What are the (cascading) climate risks we are trying to avoid?

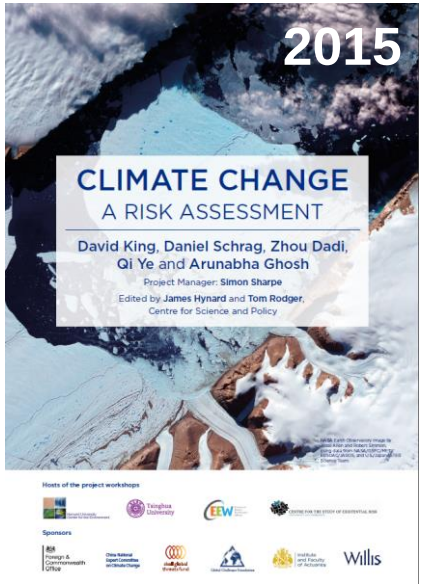
Objective and Audience of CH CCRA 2021

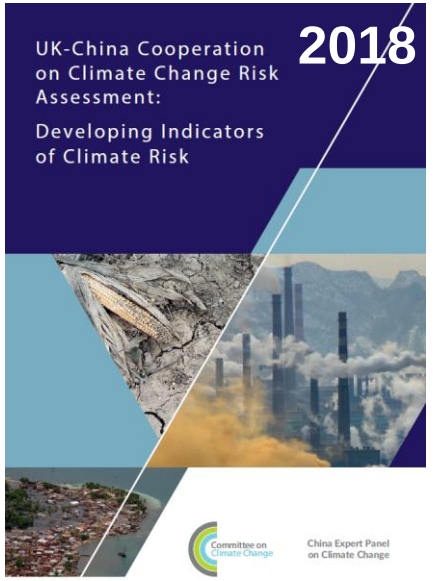
Objectives:

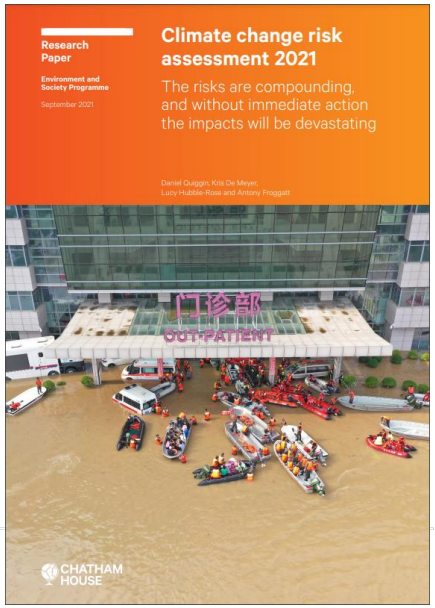
- Demonstrate to Heads of State that the impacts of climate change are severe, such that there is a greater awareness that their country's need to move heaven and earth to avoid such outcomes
- Build on phase one and two of the UK-China Co-operation on Climate Change Risk Assessment project
- To produce a holistic and succinct summary of emission and direct risks, as well as systemic and cascading risks, at the global and regional levels.

Audience:

- A 12 page summary ***for Heads of State and relevant Ministers***. Critical to engage HoS of big emitters
- Additional 50 page report covering the supporting detail and uncertainty caveats – ***for policy officials and advisors***







The *direct* climate risks are we trying to avoid

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Heatwaves

- **Already resulting in >50% COVID-19 lost working hours, per year**
- **3.9 billion exposed to major heatwaves by 2040**
- **by 2030s - 400 million unable to work outside and 10 million deaths per year**

Food & agriculture

- **Almost 50% more food need by 2050**
- **By 2040, the proportion of global cropland affected by severe drought –** equivalent to that experienced in Central Europe in 2018 (50% yield reductions) **– will likely rise to 32% each year, more than three times the historic average.**
- **During the 2040s there is a 50% chance of synchronous crop (maize) failure (US, China, Brazil and Argentina)**

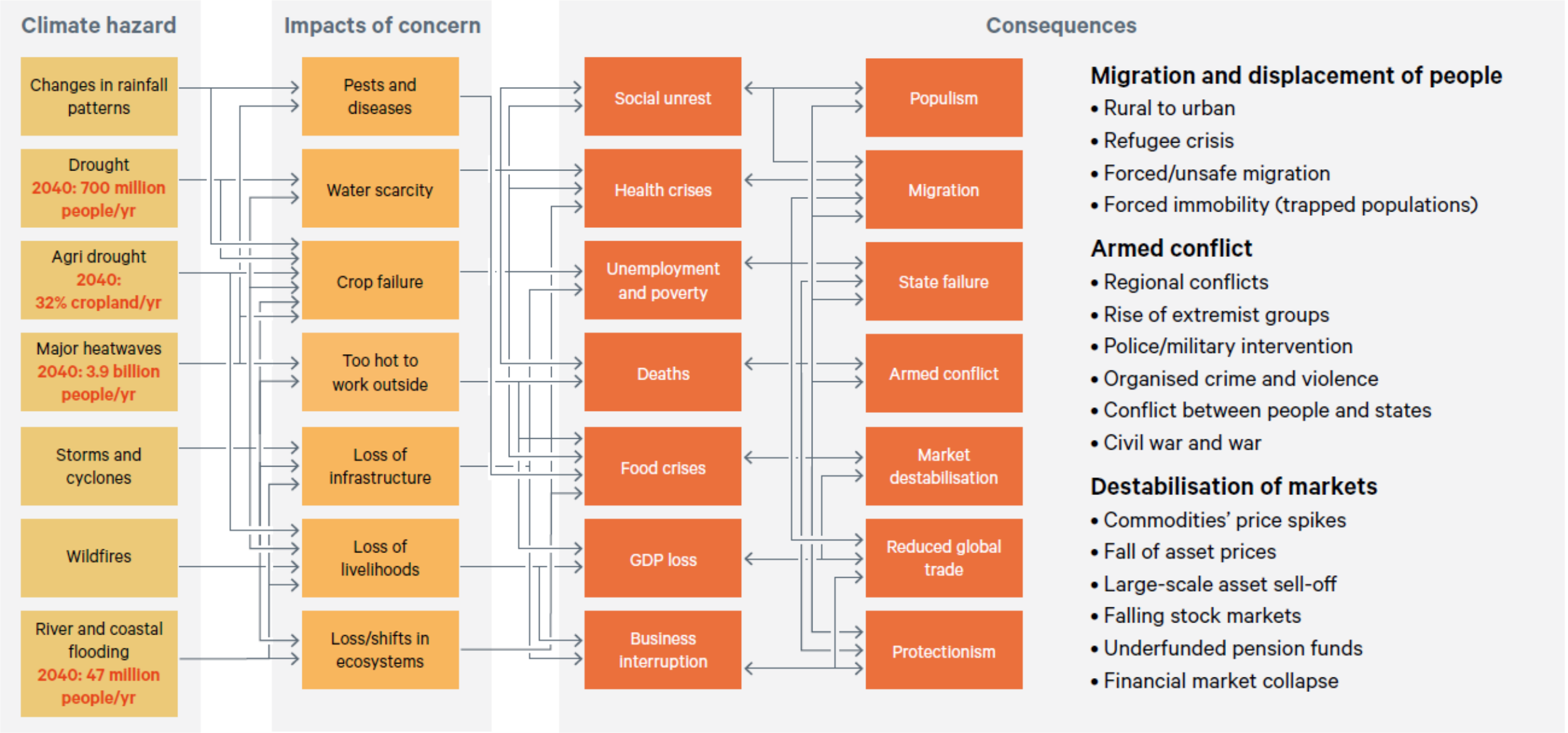
Water Security

- **By 2040, almost 700 million people a year are likely to be exposed to prolonged severe droughts of at least six months' duration, nearly double the global historic annual average.**

Many of the likely impacts of climate change will be locked in by 2040, and become so severe they go beyond the limits of what nations can adapt to, unless decarbonisation efforts are hugely ramped up

The likelihood of risks materialising into impacts over the next 10 years is much more a function of vulnerabilities in developing countries.
There is an urgent need for adaptation measures to prevent the worst direct impacts in these regions, as well as preventing cascading impacts across borders

Summary of systemic cascading risks



Migration and displacement of people

- Rural to urban
- Refugee crisis
- Forced/unsafe migration
- Forced immobility (trapped populations)

Armed conflict

- Regional conflicts
- Rise of extremist groups
- Police/military intervention
- Organised crime and violence
- Conflict between people and states
- Civil war and war

Destabilisation of markets

- Commodities' price spikes
- Fall of asset prices
- Large-scale asset sell-off
- Falling stock markets
- Underfunded pension funds
- Financial market collapse

How to interpret global cascading network diagrams

Constraint: cascading climate risks, are extremely difficult (nearly impossible) to quantify, in terms of future likelihood, frequency of occurrence and impact, based on an initial climate hazard trigger.

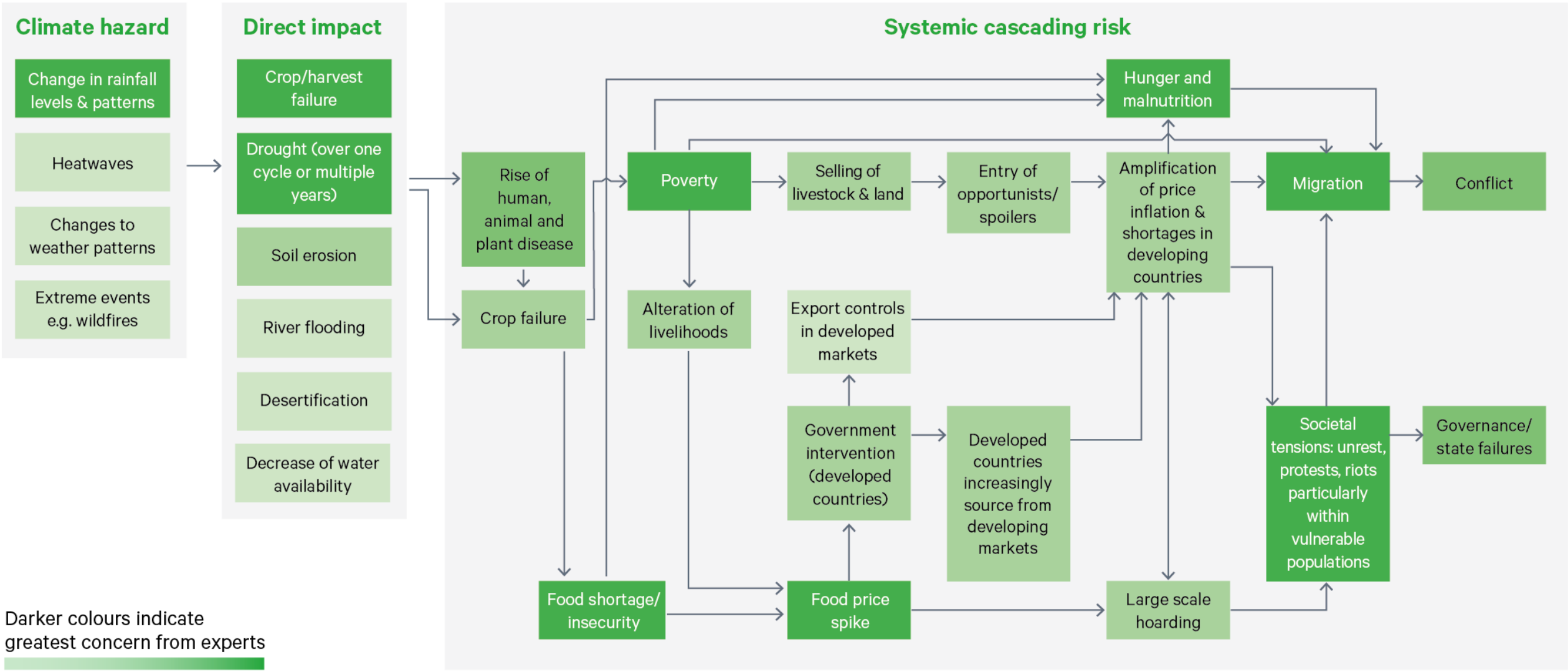
Approach: aggregated the views of climate scientists, industry and academic experts as to *future plausible risk cascades they are most concerned about*, in order to *build a comprehensive diagrammatic and narrative description of those systemic climate risks heads of state should be most concerned about*, illustrating the mechanisms most likely to amplify those risks

70 experts contributed 44 diagrams, ranging from regional specific to global in scope

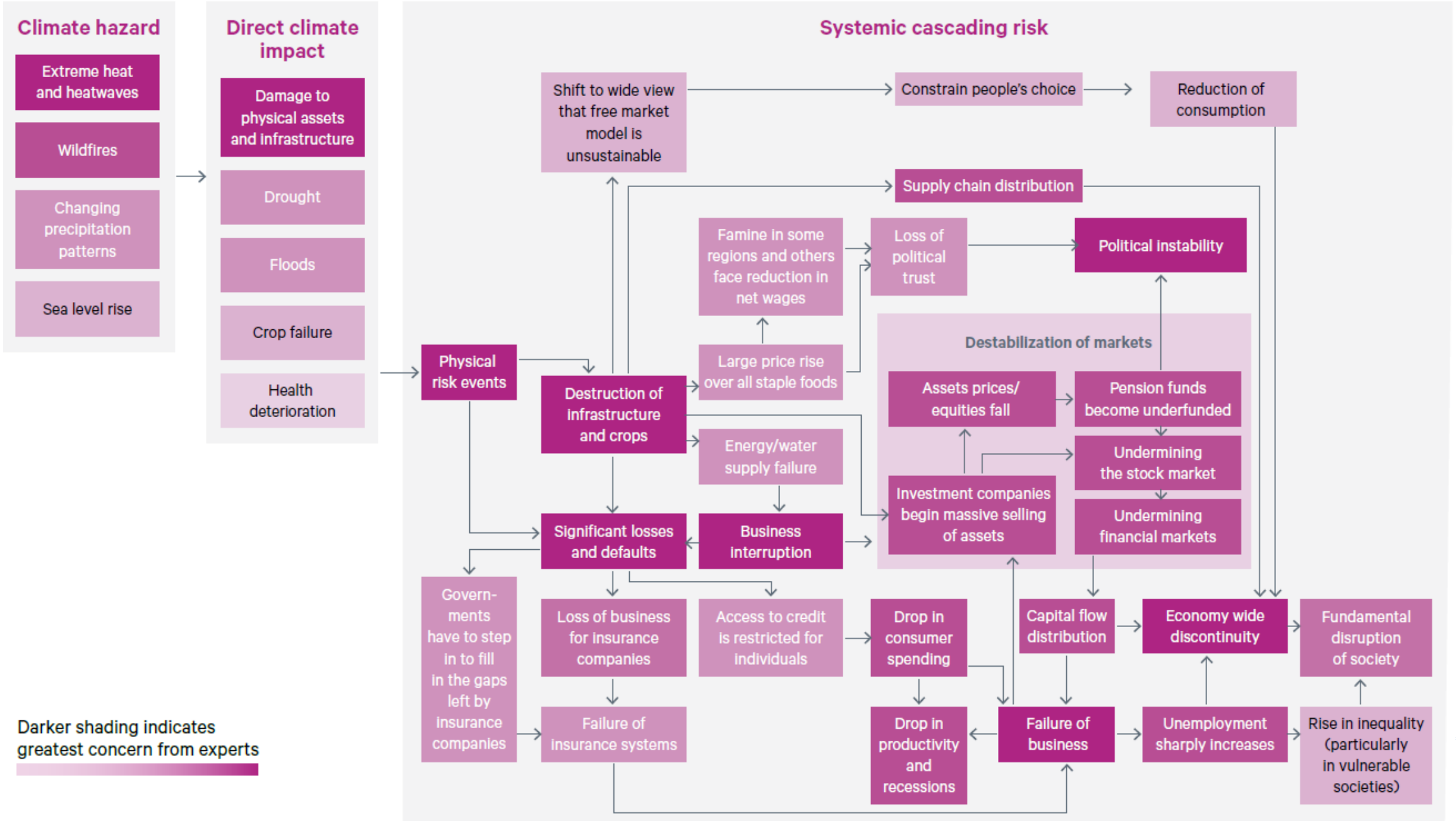
Targeted at Heads of Government: compelling & simple, whilst conveying their likely chaotic nature
Complexity and colour coding: darker colours indicate a greater number of mentions by experts

6 systemic risk diagrams
1) Food Security
2) Economics and Trade
3) National and International Security
4) Health Crises
5) Energy Supply
6) Migration and Movement of People

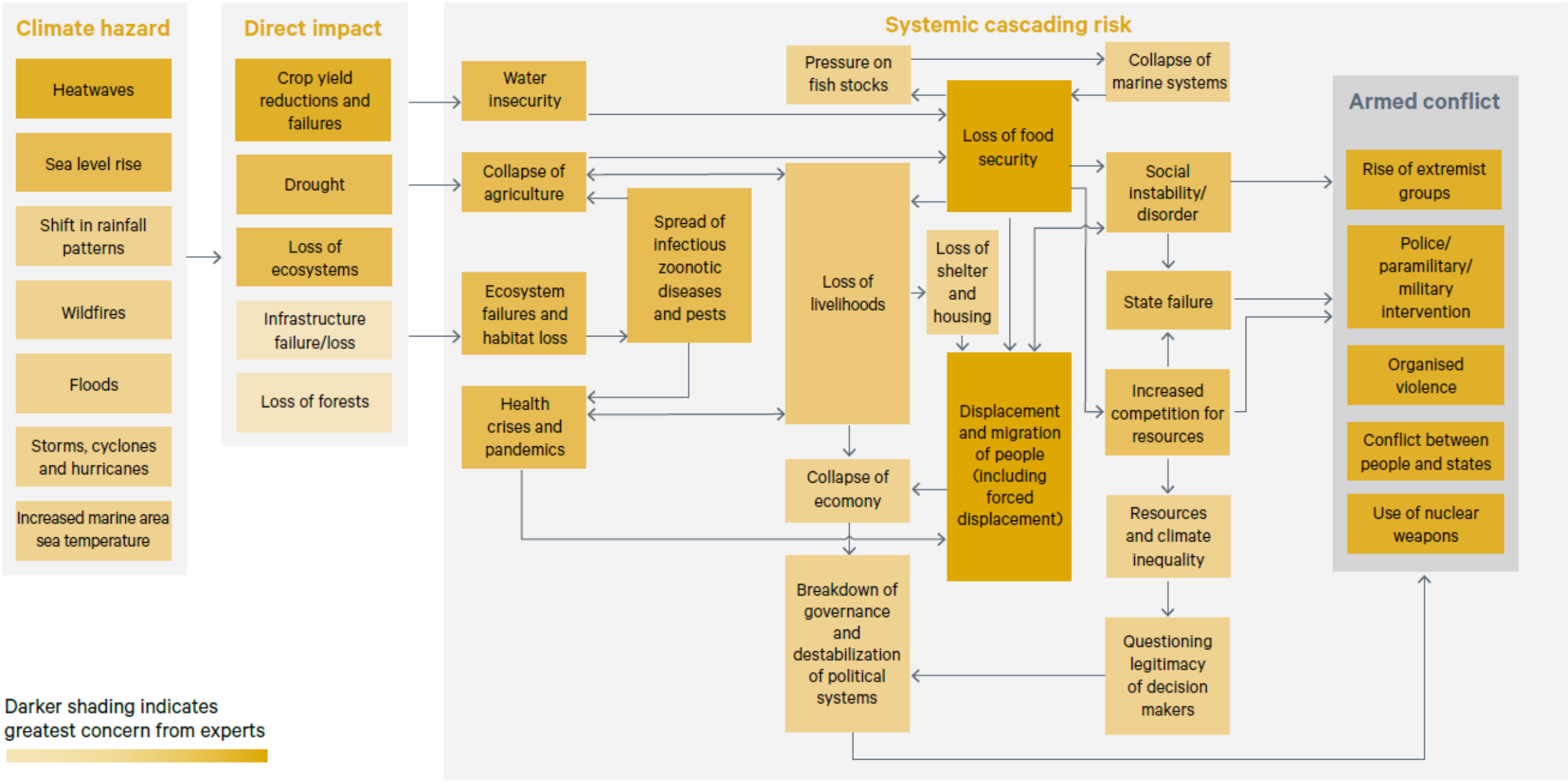
Food Insecurity



Economic and trade disruption



National and international security



Net Zero: the scaling risks of BECCS

What's so risky about negative emissions?

Cost optimisation models → BECCS and DAC selected to close the emissions gap and address residual emissions. But policy doesn't follow cost optimisation models.

- **Most relied upon NETs = Bioenergy with Carbon Capture and Storage (BECCS), and less so Direct Air Capture (DAC)**
- **Steps of BECCS;**
    1. **Utilises CO_2 absorption from air as biomass grows (photosynthesis) to remove CO_2 from atmosphere**
    2. **CCS captures that CO2 when its burnt → store in geological formations underground**
    3. **Biomass grown to replenish combusted biomass → aggregate negative emissions**
- **Thermodynamics → separating diffuse gases requires lots of energy**
- **Combustion emissions of BECCS → high concentration of CO_2 → capture process less energy intensive than DAC**

Scale of BECCS foreseen by IPCC AR6 **BECCS across scenarios likely <=2°C: in 2050 = 2.75 (0.52–9.45) GtCO2/yr removals**

At this scale the biomass feedstock required is extremely high, requiring vast amounts of woody biomass from forests, or agricultural land for energy crops

Scale increasingly being relied upon globally → likely lead to significant externalities → land tensions and therefore risk of food price inflation

AR6 (2022) risks and impacts of BECCS & Bioenergy

All are statements / excerpts from AR6 WGIII

"IAMs can provide very useful information, but this information needs to be carefully interpreted and integrated with other quantitative and qualitative inputs in the decision-making process."

- ***Bioenergy is the most land-intensive energy option***
- ***Inappropriate deployment at very large scales leads to additional land and water use to grow biomass feedstock***
- ***Biodiversity and carbon stock loss if from unsustainable biomass harvest***
- ***Competition for land with biodiversity conservation and food production***
- ***may not prove as effective as expected, and its large-scale deployment may result in ecological and social impacts, suggesting it may not be a viable carbon removal strategy in the next 10-20 years***
- ***carbon removed through BECCS could be offset by losses due to land-use change***
- ***large-scale bioenergy deployment could increase risks of desertification, land degradation, and food insecurity, and higher water withdrawals, though this may be at least partially offset by innovation in agriculture, diet shifts and plant-based proteins***

Source: IPCC WGIII AR6 Report, 2022

Where is all this biomass energy going within the CCS part of BECCS?

- **Post-combustion: stack emissions passed over solvent**
- **Molecules of the solvent attach to CO_2, which is then released from the solvent by applying heat.**
- **Heat supplied from the combustion of the initial biomass, the same heat utilized to generate electricity.**
- **As such, *energy penalty* attached to the CCS process that lowers the power efficiency relative to an equivalent unabated biomass power plant.**
- **To achieve higher capture rates, BECCS → power experience greater declines in power production efficiency.**
- **Less power production = greater cost to produce negative emissions & less displacement of fossil based generation**

Fajardy, & Mac Dowell (2017) Can BECCS deliver sustainable and resource efficient negative emissions?

the efficiency drop is between 0.95 and 1.1% points for a 10% CO_2 capture rate increase
(0.15 and 0.40 for a 10% co-firing increase)

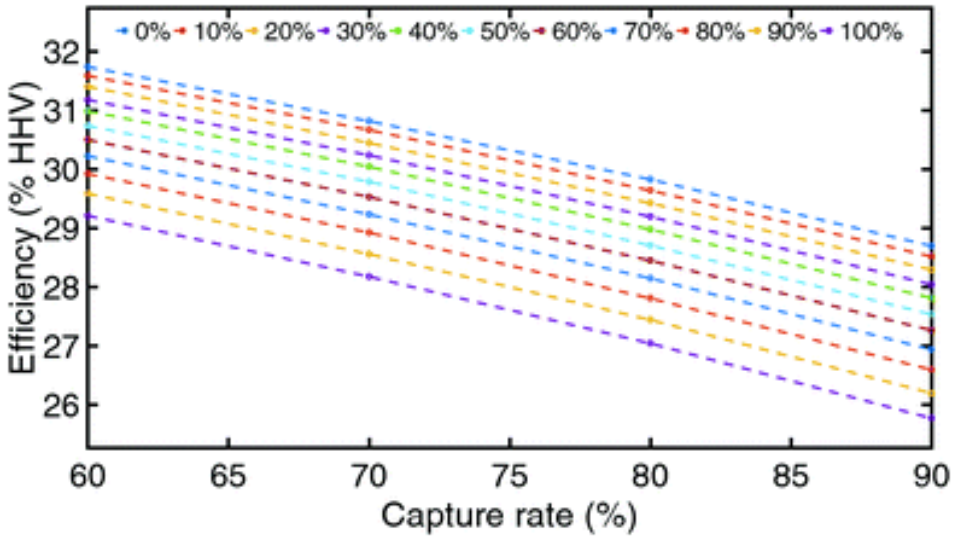


Fig. 7 500 MW supercritical coal – miscanthus pellet fired power plant efficiency (%HHV) as a function of capture and for different co-firing proportions. Efficiency decreases with capture rate, as the capture unit requires extra energy, and to a smaller extent with the increase in biomass share in the fuel.

Efficiency of BECCS plants will improve overtime with technological and solvent innovations, as well as experience learning.

But its clear that achieving high capture rates increases the energy penalty and decreases power generation efficiency

Illustrative land footprints of BECCS at global scales

	IEA net zero report	AR6 Average of likely <=2°C	AR6 max of likely <=2°C
Deployment level (GTCO2/yr)	1.3	2.75	9.45
100% wood pellets (Mt)	802	1,698	5,833
Scale up of current wood pellet supply	x 14	x 30	x 105
Scale up of current waste and residues wood pellet supply	x 34	x 72	x 246
% Forest land area using forest residues (Mha)	13%	27%	94%
100% dedicated energy crops (Mha)	58	123	422
% Global agri-land area	1.2%	2.5%	8.8%
100% Wheat Straw (Mt Wheat Grain)	844	1,785	6,134
% Global Wheat supply	110%	232%	797%

At scale BECCS risks the degradation / destruction of natural forests &/or food price inflation and insecurity

The Biomass Strategy will be key

- CCC has been clear that there are real concerns over the sustainability of imported biomass
- So what about domestic sourcing? Ofgem data shows some feedstock types exhibit declining supply chain emissions, BUT feedstocks with high LCA are forming an increasing proportion of the total supply portfolio

CCC Progress Report is clear the Biomass Strategy…

- *set out how it will ensure the sustainability of the full amount of bioenergy feedstock needed for BECCS. This should set out how domestic biomass feedstock supplies can be expanded to avoid overreliance on imported biomass, for example through policies on diet change to make more UK land available*
- *needs to be part of a comprehensive land use strategy, including setting out how land for UK biomass and forestry will be freed up (e.g. through reduced livestock farming as a result of diet changes).*
- *set out best-use hierarchies for biomass, how sustainability requirements for feedstocks will be met, and demonstrate how these align with plans for BECCS deployment.*
- *address the findings of the IPCC Working Group III Report on the risks of biomass demand to biodiversity and land carbon stocks.*
- *Should the Biomass Strategy find that insufficient quantities of sustainable biomass feedstock will be available, Government should plan how this shortfall can be made up through either, or a combination of, other engineered removal approaches and deeper emissions reductions*

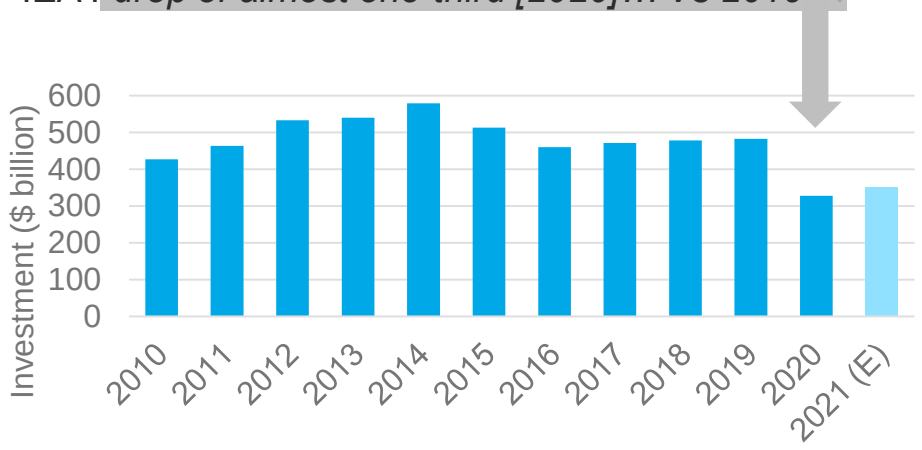
Risk minimisation: demand side offers a climate crisis - Russia crisis win-win

Pre-invasion: O&G investment declines → limited supply capacity

Upstream O&G E&P investment sharply declines

Off the back of 2015 & 2016 cuts in upstream investment

IEA :*"drop of almost one-third [2020]… Vs 2019"*



Very little fat in the system to be trimmed (this time)

Oil price fall in 2014:

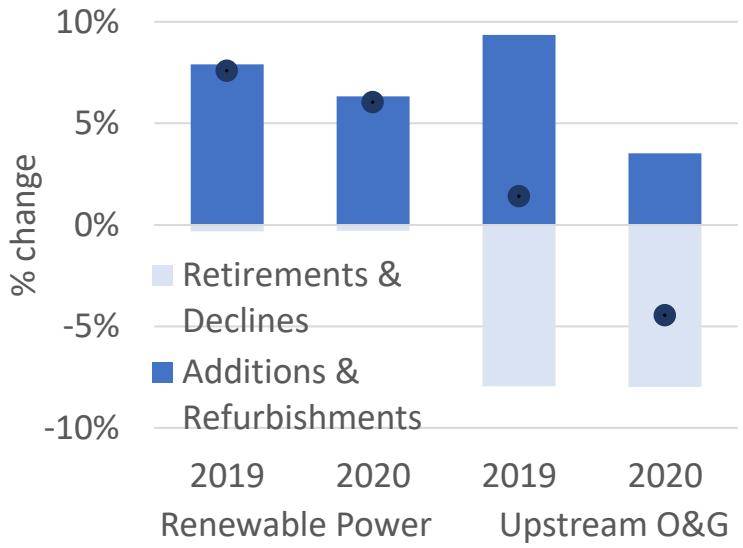
- CAPEX cuts mitigated by declines in upstream costs
- 40% reduction in nominal spending from 2014 to 2019 = [only] 12% reduction in upstream activity

2020/21 investment declines

- more likely to translate into production declines (medium-long term), and short term constraints to production growth

Resulting in…

…upstream O&G infrastructure retirements outpacing additions



So… Pre-invasion: scope for increased production limited in short term. Higher prices will stimulate ramp-up, but will take time

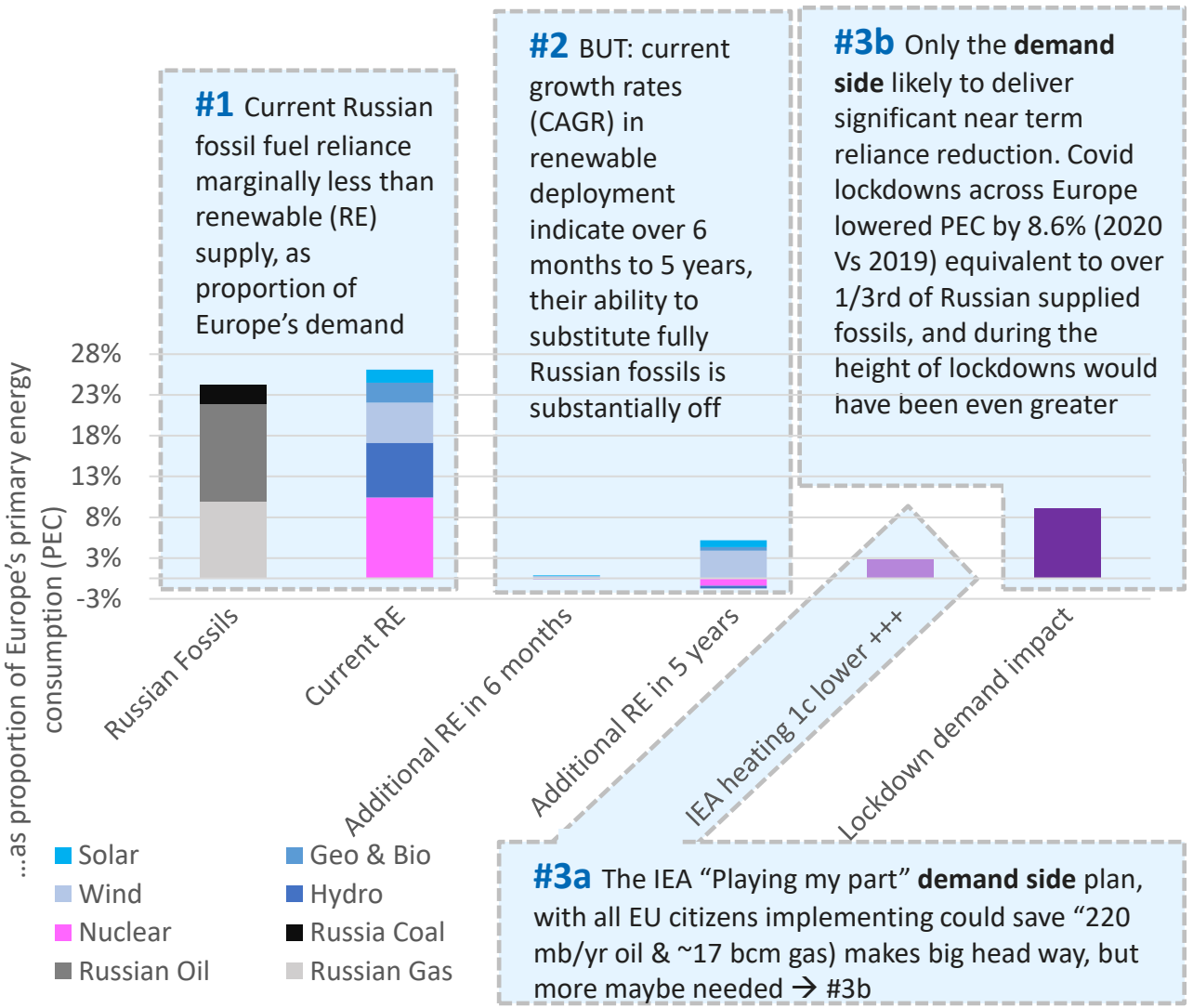
Source: IEA, World Energy Investment 2020 & 2021 & EIA

How has the Russian invasion and resulting dynamics changed the transition?

- Decline in O&G investment led to tight supply-demand, leading to high O&G prices, which arguably would have happened regardless of the invasion and resulting dynamics.
- Irrespective, if there were less tight O&G markets & greater spare capacity, governments less likely to feel the pressure of developing new O&G assets
- Underinvestment + invasion → all-of-the-above approach = renewables + non-Russian fossil substitutes, WHILST seeking new fossils exploration and production
- All-of-the-above → greater overshoot → more reliance on NETs
- Negative emissions are increasingly creating cover for governments being able to say we are on track to avert/minimise climate change, even as they pursue all-of-the-above.

All-of-the-above approach → more reliance on GGRs → more risk

If not non-Russian-fossils for Russian-fossils, what should Europe pursue?



Energy efficiency measures and behaviour change based demand reduction can be swiftly implemented….
if political will exists and communication with the public is prioritised

Demand side likely to prove crucial if crisis escalates

Sources: Internal analysis & BP statistical review 2021 & https://ukerc.ac.uk/news/turning-down-your-thermostat/#:~:text=Recently%2C%20the%20International%20Energy%20Agency,Europe's%20annual%20imports%20from%20Russia & https://www.eea.europa.eu/ims/primary-and-final-energy-consumption ; IPCC AR6 WGIII report (2022); www.iea.org/news/energy-saving-actions-by-eu-citizens-could-save-enough-oil-to-fill-120-super-tankers-and-enough-natural-gas-to-heat-20-million-homes

Demand side focus: a potential Russia crisis – climate crisis win-win?

IPCC AR6 WGIII mitigation report increasingly highlighting importance of demand side

- *Demand-side measures… can reduce global GHG emissions in end use sectors by 40-70% by 2050 compared to baseline scenarios… while some regions require additional energy*
- *Decent living standards are achievable at lower energy demand than previously thought (high confidence)… & exhibit reduced trade-offs and negative consequences* [for SDGs] *relative to pathways with high consumption and emissions that are ultimately compensated by large quantities of BECCS.*
- *Stronger emphasis on demand-side mitigation [leads to]… less dependence on CDR… reduced pressure on land and biodiversity.*

- Invasion and resulting price rises could be seen as a good thing for the energy transition – as inflation is leading to demand destruction, but comes with the huge downside of awful impacts for fuel poor, vulnerable households
- There are potential ways to square this circle; free insulation for vulnerable households, mandate improvements in EPCs during house sales, more subsidies for EVs, higher energy bill relief targeted more precisely at vulnerable households
- Govs needs to think about how to protect the vulnerable WHILST locking-in and accelerating the good aspects of inflation driven energy demand destruction / reduction

Conclusions

- Many of the likely impacts of climate change will be locked in by 2040, and become so severe they go beyond the limits of what nations can adapt to
- Cascading climate risks: negative & compounding feedback loops are likely, involving shifting weather patterns and ecosystems, increased pests and diseases, heatwaves and drought, driving unprecedented food insecurity, migration, higher mortality rates, political instability and conflict.
- Trilemma (decarbonisation - security - affordability) never more acute. We are at risk of increasing our reliance on NETs (mainly BECCS) as governments pursue an all-of-the-above approach to the Russia crisis to address security and affordability, compounding the scaling risks of BECCS
- If BECCS/DAC underdeliver / create externalities at scale (food price inflation &/or degradation of forests) we will have either run away climate change, or food insecurity – or both
- BECCS energy penalty → less power generation → removals more costly & less displacement of higher emitting sources → more renewables and demand reduction (/?) required

What is needed?

- Reform Net Zero: creating separated reductions & removals targets, reviewed annually, prioritising reductions in the short term. Removals target can increase overtime as BECCS/DAC empirically prove themselves
- HMG should ensure greater transparency from companies conducting BECCS R&D / pilots / 1st commercial projects on performance (inclusive of land take, soil carbon etc), such that reliance risks can be reduced
- Enforce tighter supply chain emission regulations, that are well monitored and verified; likely to be more attainable if feedstocks are domestically grown.
- Climate and Russia crisis win-win = greater focus on the demand side whilst protecting the most vulnerable, capable of delivering near term Russian reliance reductions and preventing over reliance on BECCS/DAC

Thanks for listening

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