# Global Carbon Markets & Local Impacts

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#### Societal impacts matter for participation in global carbon markets & enhancing climate ambition

- Mitigation links to other national priorities social well being, environmental protection, economic prosperity
- Local implications on the basic F-E-W nexus and international implications on ambition & participation
- For many regions, societal and climate goals are inextricably linked
- Ambition affected by distributional effects being synergistic or antagonistic
- Important for framing international agreements
- Need for a structured analysis

#### **Research Question**

What are the local distribution implications of global carbon markets along the F-E-W nexus?

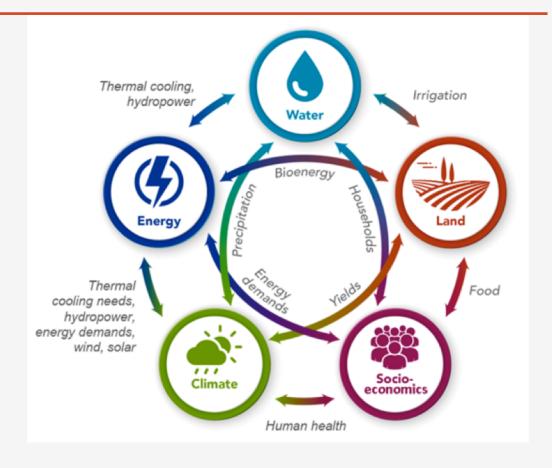
Pathways: (a) Global Net Zero CO2 attained in 2050

(b) Equity-based net zero CO2 attainment

- Effect of design
  - Inclusion of nature-based mitigation options?
- Effect of equity-oriented pathways
  - Varying regional net zero year
- Short vs long term impacts
  - o 2030 & 2050

#### IAMs are well-suited for F-E-W analysis

- IAMs capture many interlinkages, cross-sector implications
- GCAM: Global Change Analysis Model
  - Hector climate model, v2.5
  - 32 global energy-economy regions
  - o 384 land regions
  - 235 water basins



Calvin et al. 2019

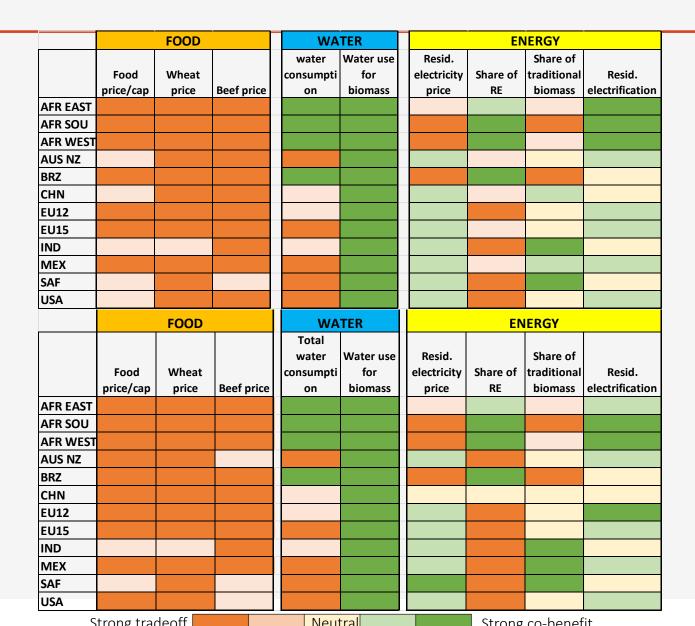
### Effect of Market Design: Varying levels of nature-based mitigation options

	FOOD			WA	TER			EN	IERGY	
			wa	ter	Water use		Resid.		Share of	
Food	Wheat		consu	mpti	for		electricity	Share of	traditional	Resid.
price/cap	price	Beef price	0	n	biomass		price	RE	biomass	electrification
	FOOD			14/0	TED	Ī			IEDCV	
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Food	Wheat							Shara of		Resid.
		Reef nrice		-	_		-			electrification
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	Food price/cap  Food price/cap	Food Wheat price  FOOD  Food Wheat price	Food Wheat price Beef price  FOOD  Food Wheat	Food Wheat price Beef price of the price of	Food Wheat price Beef price on Supplies on Supplies Suppl	Food Wheat price Beef price on biomass  FOOD Water use for biomass  Water use for biomass	Food Wheat price Beef price on biomass  FOOD WATER Food Wheat price Beef price on biomass  Water use for biomass  Water use for biomass  Water use for biomass  Water use for biomass	Food Wheat price Beef price on biomass Price Price Price On Biomass Price Price On Biomass Price Price Price On Biomass Price	Food Wheat price Beef price on biomass Price RE  Water use for Beef price RE  Water use for Beef price RE  Water use for Resid. electricity Share of Share of Resid. electricity Share of Shar	Food Wheat price Beef price on biomass Price RE biomass Beef price on biomass Price RE biomass Beef price on

### Effect of Market Design: Excluding nature-based mitigation options

	FOOD		WATER		ENERGY				
				water	Water use	Resid.		Share of	
	Food	Wheat		consumpti	for	electricity	Share of	traditional	Resid.
	price/cap	price	Beef price	on	biomass	price	RE	biomass	electrification
AFR EAST									
<b>AFR SOU</b>									
<b>AFR WEST</b>									
AUS NZ									
BRZ									
CHN									
EU12									
EU15									
IND									
MEX									
SAF									
USA									

#### Effects with equity-oriented net zero pathways



### Short- & Long-Term Impacts: Net zero in 2050 pathways

0000			FOOD		W.A	TER		EN	IERGY		
2030					water	Water use	Resid.		Share of		
		Food	Wheat		consumpt		electricity	Share of	traditional	Resid.	
		price/cap	price	Beef price	on	biomass	price	RE	biomass	electrification	
	AFR EAST										
	AFR SOU										
	AFR WEST										
	AUS NZ										
	BRZ										
	CHN										
	EU12										
	EU15										
	IND										
	MEX										
	SAF										
	USA										
2050			FOOD		WA	TER		EN	IERGY		
					water	Water use	Resid.		Share of		
		Food	Wheat		water consumpt		Resid. electricity	Share of	Share of traditional	Resid.	
		Food price/cap	Wheat price	Beef price				Share of RE		Resid. electrification	
	AFR EAST			Beef price	consumpt	for	electricity		traditional		
	AFR EAST AFR SOU			Beef price	consumpt	for	electricity		traditional		
		price/cap		Beef price	consumpt	for	electricity		traditional		
	AFR SOU	price/cap		Beef price	consumpt	for	electricity		traditional		
	AFR SOU AFR WEST	price/cap		Beef price	consumpt	for	electricity		traditional		
	AFR SOU AFR WEST AUS NZ	price/cap		Beef price	consumpt	for	electricity		traditional		
	AFR SOU AFR WEST AUS NZ BRZ	price/cap		Beef price	consumpt	for	electricity		traditional		
	AFR SOU AFR WEST AUS NZ BRZ CHN	price/cap		Beef price	consumpt	for	electricity		traditional		
	AFR SOU AFR WEST AUS NZ BRZ CHN EU12	price/cap		Beef price	consumpt	for	electricity		traditional		
	AFR SOU AFR WEST AUS NZ BRZ CHN EU12 EU15	price/cap		Beef price	consumpt	for	electricity		traditional		
	AFR SOU AFR WEST AUS NZ BRZ CHN EU12 EU15 IND	price/cap		Beef price	consumpt	for	electricity		traditional		
	AFR SOU AFR WEST AUS NZ BRZ CHN EU12 EU15 IND MEX	price/cap		Beef price	consumpt	for	electricity		traditional		

## Short- & Long-Term Impacts: Equity-oriented pathways

		FOOD		WATER		ENERGY				
				Total						
				water	Water use	Resid.		Share of		
	Food	Wheat		consumpti	for	electricity	Share of	traditional	Resid.	
2030	price/cap	price	Beef price	on	biomass	price	RE	biomass	electrification	
AFR EAST										
AFR SOU										
<b>AFR WEST</b>										
<b>AUS NZ</b>										
BRZ										
CHN										
EU12										
EU15										
IND										
MEX										
SAF										
USA										
		FOOD	,	WA	TER		EN	IERGY		
		FOOD		WA Total	TER		EN	IERGY		
		FOOD			TER Water use	Resid.	EN	Share of		
	Food	FOOD Wheat		Total	Water use for	Resid.		Share of traditional	Resid.	
2050	Food price/cap		Beef price	Total water	Water use			Share of	Resid. electrification	
2050 AFR EAST		Wheat	Beef price	Total water consumpti	Water use for	electricity	Share of	Share of traditional		
-		Wheat	Beef price	Total water consumpti	Water use for	electricity	Share of	Share of traditional		
AFR EAST	price/cap	Wheat	Beef price	Total water consumpti	Water use for	electricity	Share of	Share of traditional		
AFR EAST AFR SOU	price/cap	Wheat	Beef price	Total water consumpti	Water use for	electricity	Share of	Share of traditional		
AFR EAST AFR SOU AFR WEST	price/cap	Wheat	Beef price	Total water consumpti	Water use for	electricity	Share of	Share of traditional		
AFR EAST AFR SOU AFR WEST AUS NZ	price/cap	Wheat	Beef price	Total water consumpti	Water use for	electricity	Share of	Share of traditional		
AFR EAST AFR SOU AFR WEST AUS NZ BRZ	price/cap	Wheat	Beef price	Total water consumpti	Water use for	electricity	Share of	Share of traditional		
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AFR EAST AFR SOU AFR WEST AUS NZ BRZ CHN EU12	price/cap	Wheat	Beef price	Total water consumpti	Water use for	electricity	Share of	Share of traditional		
AFR EAST AFR SOU AFR WEST AUS NZ BRZ CHN EU12 EU15	price/cap	Wheat	Beef price	Total water consumpti	Water use for	electricity	Share of	Share of traditional		
AFR EAST AFR SOU AFR WEST AUS NZ BRZ CHN EU12 EU15 IND	price/cap	Wheat	Beef price	Total water consumpti	Water use for	electricity	Share of	Share of traditional		

#### Summary

- Effect of market design:
  - LUC pricing dampens cobenefits & tradeoffs
  - Shifting of mitigation from land to energy sector
- Effect of equity-based pathways: Generally, more beneficial to vulnerable regions
- Short term vs long term: Long term impacts are dampened based on stringency of target
- Complex interactions and priorities for different regions
  - Implications for global cooperation
  - Implications for market design
- Does not include climate impacts

#### **Policy Implications**

- Local impacts & global market design:
- (a) actively promote attainment
- (b) avoid/minimize/mitigate negative SD effects
- Choice for countries as winners/losers: innovate to maximize SD synergies and minimize tradeoffs,
   redistribution of benefits from trade
- Net effects will depend on pace of transition, magnitude of mitigation effort, management of change
- Opens options for premium carbon pricing by project impact

# Questions & comments welcome

Thank you