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Forretningsmodellar for Fortum Oslo Varme

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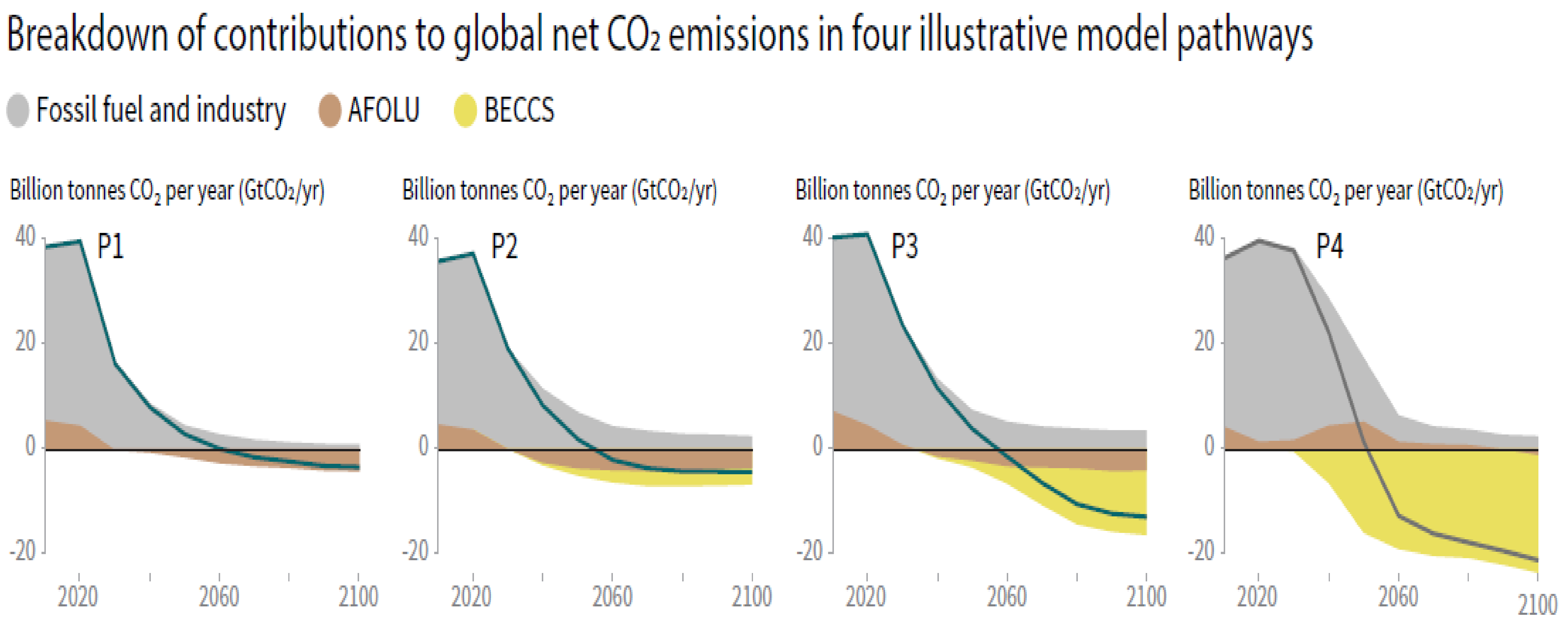
PLATON, CCS Workshop , 19. november 2021

Mitigation and/or carbon dioxide removal ?



P1: A scenario in which social, business and technological innovations result in lower energy demand up to 2050 while living standards rise, especially in the global South. A downsized energy system enables rapid decarbonization of energy supply. Afforestation is the only CDR option considered; neither fossil fuels with CCS nor BECCS are used.

P2: A scenario with a broad focus on sustainability including energy intensity, human development, economic convergence and international cooperation, as well as shifts towards sustainable and healthy consumption patterns, low-carbon technology innovation, and well-managed land systems with limited societal acceptability for BECCS.

P3: A middle-of-the-road scenario in which societal as well as technological development follows historical patterns. Emissions reductions are mainly achieved by changing the way in which energy and products are produced, and to a lesser degree by reductions in demand.

P4: A resource- and energy-intensive scenario in which economic growth and globalization lead to widespread adoption of greenhouse-gas-intensive lifestyles, including high demand for transportation fuels and livestock products. Emissions reductions are mainly achieved through technological means, making strong use of CDR through the deployment of BECCS.

- Reduction: Too little to late to meet less than 2 ºC climate goal
- Extensive emission reduction from some sectors difficult – like agriculture
- Likely ‘overshoot’ situation

Source: IPCC 2018, Global warming of 1.5 ºC

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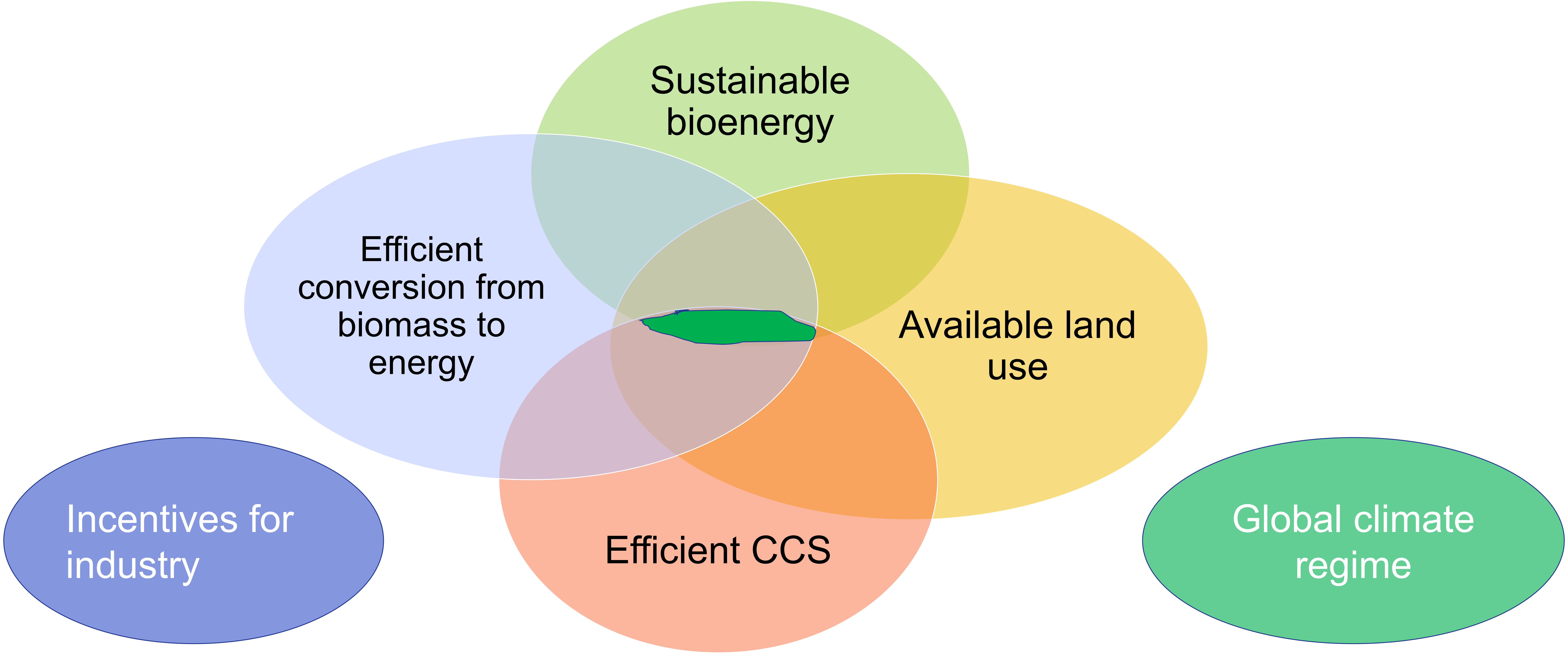
Huge carbon gap - need Negative Emission Technologies (NET)?

- Studies: 2 °C target difficult without Negative Emission Technologies (NETs).
- NET impact the ‘carbon budget’
- Both BECCS and DAC depend on CCS
- Biomass essential for BECCS, forestation and biochar
- Why so little NET?:
  * Decision makers don’t understand or trust science?
  * Expensive.
  * Need long-term government support.
  * Climate policy is uncertain.
  * Uncertain need for NET?
  * Sufficient with carbon-free technologies (sun, wind, etc..)

Paris Agreement

- "… conserve and enhance, as appropriate, sinks and reservoirs of greenhouse gases …". Paris Agreement Article 5.1
- Reporting of actions under Nationally Determined Contributions
- International mitigation: Internationally Transferred Mitigation Outcomes; Article 6.2. Emission Mitigation Mechanism; Article 6.4
- Use experience from CDM: Balance between 'perfect'/expensive and efficient/operational/realistic
- After Glasgow COP: More mitigation/carbon collaboration/trading between indus. and dev. countries

Verdikjede for biobaserte negative utslepp: Effektiv, berekraftig, interessant for bedrifter



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Accounting negative emissions - Scalability

- **Net CO_2 removal?** Losses due to production, transport, conversion, bioenergy use. Rebound effect from global carbon cycle
- **Sustainability** and land use competition: eco-system, biodiversity, crops; lifecycle, re-growth, carbon storage, replace fossil fuels?
- **Life cycle** assessment? How much include?
- **CCS** - Net captured and stored CO_2: Realistically 90 % of CO_2 captured; Monitoring of stored CO_2
- **Trade**: CO_2 transportation between countries

Market mechanisms alignment

- Depends on handling of sinks (forests, land use) and CCS
- Difficult to handle by regional cap&trade schemes, since biomass included in ‘baseline’, or biomass entities excluded (e.g. EU ETS).
- Negative emissions easier to include in project-based schemes. Clean Development Mechanism (CDM) accounting can be model, but BECCS should be more standardized and simpler
- Negative emissions included as ‘credits’; or ‘net-back’ - subtracted from positive emissions in a broad emissions portfolio

Huge gap between need for CO_2 removals and policy making

- Not much policies and regulations established:
  Accounting
  Rewarding
  Paris Agreement alignment

- E. g. CDR not aligned with EU's emissions trading system

- Skepticism due to:
  * 'Moral hazard'
  * Assumption of 'neutral' biomass
  * Land use and sustainability

- CDR policy development in nine OECD cases

- The UK: proactive CDR policies; Sweden: most advanced CDR policy;
  Norway: CCS entrepreneur

- EU is developing CO_2 removal certification scheme for next year

frontiers in Climate

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Check for updates

Carbon Dioxide Removal Policy in the Making: Assessing Developments in 9 OECD Cases

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Since the adoption of the Paris Agreement in 2015, spurred by the 2018 IPCC Special Report on Global Warming of 1.5°C, net zero emission targets have emerged as a new organizing principle of climate policy. In this context, climate policymakers and stakeholders have been shifting their attention to carbon dioxide removal (CDR) as an inevitable component of net zero targets. The importance of CDR would increase further if countries and other entities set net-negative emissions targets. The scientific literature on CDR governance and policy is still rather scarce, with empirical case studies and comparisons largely missing. Based on an analytical framework that draws on the multi-level perspective of sociotechnical transitions as well as existing work on CDR governance, we gathered and assessed empirical material until early 2021 from 9

CO_2-fjerning frå anlegg for avfallsforbrenning

Avfallsforbrenning 'lågt-hengande frukt' for negative utslepp?

Fjerne avfall, hindre metan, produsere fjernvarme og kraft, fjerne fossilt karbon, negative utslepp frå biogent karbon)

Rundt 500 anlegg i Europa åleine.

CO_2 capture pilot at Fortum Oslo Varme AS, Klemetsrud

Staten vil finansiere CCS for Norcem/sement/Brevik.

Siste: Kostnadsauke 912 mill. Kven betale?

Staten finansiere 50% av CCS ved Fortum Oslo Varme – på vilkår av at dei skaffar resten av finansieringa sjølv.

Siste: Avslag frå EU sitt innovasjonsfond (søkte 1,8 mrd. NOK).

Forretningsmodellar for negative utslepp frå avfallsforbrenning

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Business Models for Negative Emissions From Waste-to-Energy Plants

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Negative emissions of carbon dioxide will likely be needed to meet the <2°C warming above the pre-industrial level goal of the Paris Agreement. A major technology option is combining Biomass Energy with Carbon Capture and Storage (BECCS) in the industry and power sectors. Biogenic waste contributes a major share for the numerous waste-to-energy plants around the world. This implies that adding a CCS facility to a waste-to-energy plant could establish a value chain for negative carbon dioxide emissions. Hence a waste-to-energy plant could deliver four services to society: waste management and avoided pollution, service district heating system, remove carbon dioxide from fossil-based waste categories, and generate negative carbon dioxide emissions from biogenic waste. A major barrier to deploying Bio-CCS at a waste-to-energy plant is a high investment and operation cost for the carbon dioxide capture plant, combined with lacking reward for the negative carbon dioxide emissions. In this paper I explore promising business models that could incentivize owners of waste-to-energy plants to install CCS facilities, assuming that government has established an infrastructure for transportation and permanent storage of carbon dioxide, as well as the basic framework for accounting for negative emissions. The business models are either founded on waste renovation customers being able and willing to pay for the additional cost of producing negative emissions of carbon dioxide directly or through certificates, or investments in CCS being incentivized by government through a guaranteed price or tax rebates for negative emissions of carbon dioxide.

Keywords: negative emissions, carbon capture and storage, waste-to-energy (WTE) plants, incentives for industry, business models

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Specialty section:

Business models

- ❑ Increased waste fee
- ❑ Certificates for negative emissions
- ❑ Government guaranteed price (‘Contracts for difference’)
- ❑ Government tax credit

Eksempel: Fortum Oslo Varme AS – Auka gebyr på avfallshandtering

TABLE 1 | Cost of full-scale carbon dioxide capture at the Fortum Oslo Varme waste-to-energy plant.

Case for calculating waste fee	Waste fee, NOK per ton of waste	Annual waste fee for an average household or business, NOK
Current fee for mixed household and business waste[a]	3187	9561
Additional waste fee to cover cost of carbon dioxide capture facility	2716	8148
Waste fee included full cost of carbon dioxide capture facility	5903	17709

[a] The waste fee is calculated as the average annual waste fee for a 400 liter container in Oslo for households (NOK 10463) and business (NOK 9426). Based on net present value calculations with 25-year time horizon and 3% discount rate.

Rekneeksempelet byggjer på:

- 200 ktonn biogent avfall; 200 ktonn fossil avfall.
- Investeringskostnad karbonfangst 4,5 mrd.
- Driftskostnad 230 mill./år.
- Nettoverdien av kostnader over 25 års periode.
- Avfallsgebyr for i snitt 400 liters søppeldunk for hushald og bedrifter.
- Diskontering på 2 til 5 %.

Ekstra

Rewarding BECCS

- BECCS cost 70–250 USD/ton CO_2. EU ETS (Futures): 68 Euro/tonCO_2 17 Nov. 2021.
- Also significant risks for industry in BECCS investments.
- Substantial, early government support: Enabling framework and money.
- Support later reduced if carbon price picks up, and learning reduces cost.
- Removal not same as avoided emissions.
- Discounting due to carbon cycle interaction?
- Additional value to BECCS in case of ‘overshoot’ situation?