

# CINeLDI

Centre for intelligent electricity distribution  
- to empower the future Smart Grid

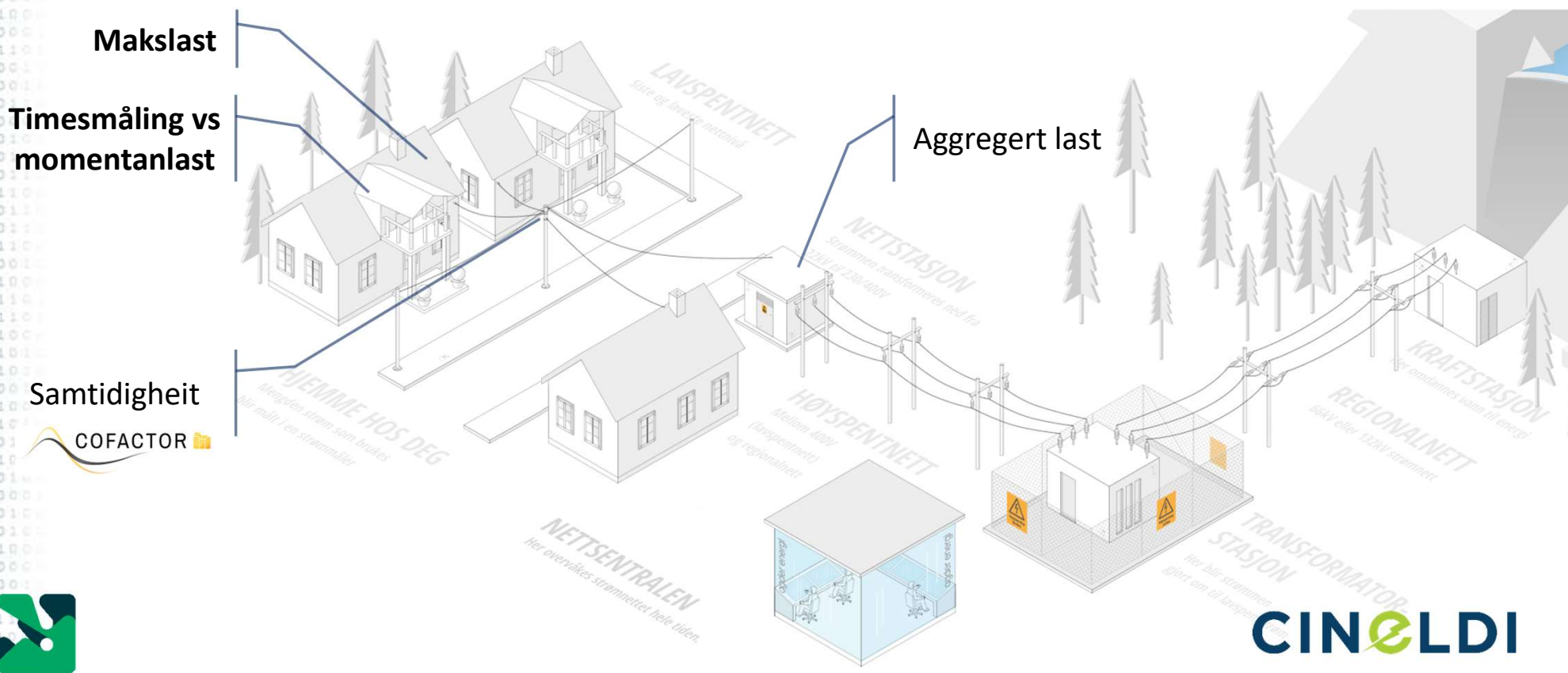


Centres for  
Environment-friendly  
Energy Research

## Verktøy for nettplasslegging under usikkerhet

Per-Oddvar Osland, forskningsleder i Glitre Nett  
Susanne Sandell, forsker i SINTEF Energi

# Effektanalyse – grunnlag for nettplanlegging



# Kva er makslast (kWh/h) til ein kunde?



– Velanders formel

$$P_{\max} = k_1 * W + k_2 * \text{Sqrt}(W)$$

– Brukstid

$$P_{\max} = W / \text{brukstid}$$

(W = årsforbruk, kWh)

– Statistisk modell

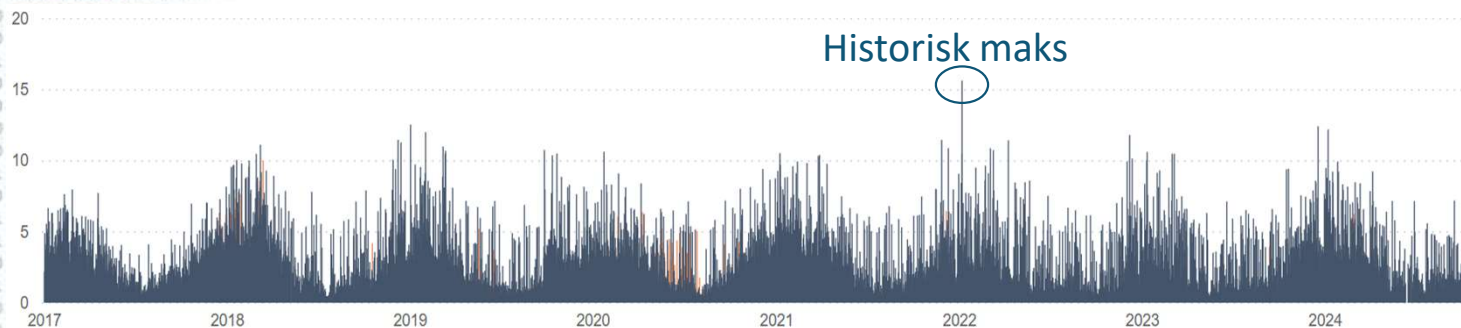
Regresjonsanalyse

– Stokastisk modell

Regelmessige mønster +  
stokastisk variasjon

– Maskinlæring


Maks last basert på  
inputdata og trening



➔ **Framtidig maks?**

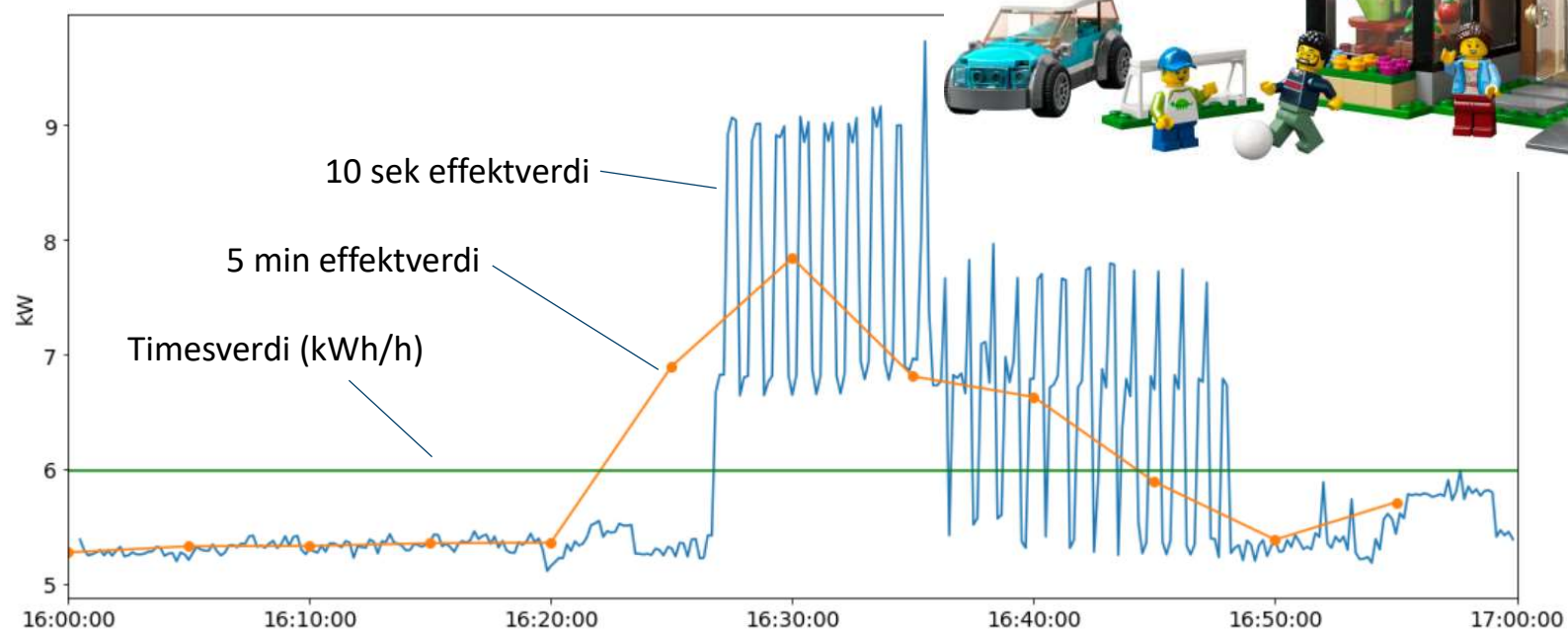
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# Kva for ein modell er best?

Modell	Pluss	Minus
<b>Velanders formel</b>	Enkel og velkjent	Underestimerer makslast
<b>Brukstid</b>		Upresise estimat
<b>Statistisk modell (regresjonsanalyse)</b> 	Beste modell - mest presis!	Krev parametertilpassing
<b>Stokastisk modell</b>	Modellerer heile året	Mykje modellering
<b>Maskinlæring</b>	Nest beste modell, presis	Risiko for overtilpasning (lite robust)

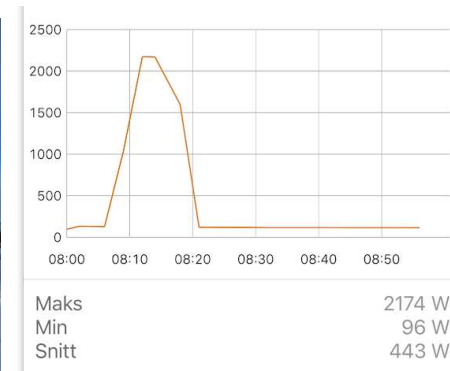


# Timesmåling vs momentanlast

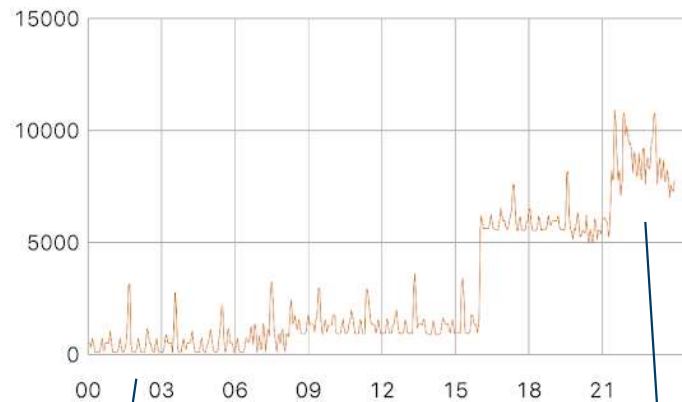


# Observasjon - kundetypar

- Husholdningsforbruk og hytteforbruk har ulik effektvariasjon – Hytter har i større grad høge effektverdier innanfor ein time
- Husholdning og næring er like når det gjeld høge verdier innanfor ein time



# Observasjon – høg vs lav last



Lav last:

Maks momentaneffekt =  
**2 x timesverdi**

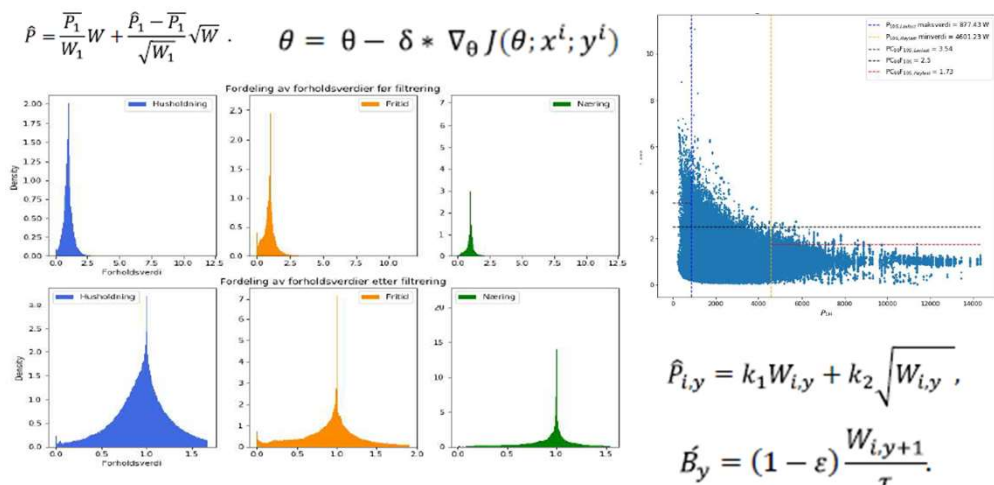
Høg last:

Maks momentaneffekt =  
**1,5 x timesverdi**



# Sluttrapport, Pilot Effektanalyse

<https://www.sintef.no/projectweb/cineldi/pilot-projects-in-cineldi/risk-based-distribution-network-planning/>



$$v_i(n) = \left( \frac{\sum_{n=1}^{N_i} w_i(n)}{N_i} \right) M_{w_i(n),m} \overline{M_{l,m}} (U_{w_i(n),h} \overline{U_{l,h}} + H_{w_i(n),h} \overline{H_{l,h}}) , \forall n.$$

$$\hat{P}_{i,y} = \bar{P}_{i,y} + k \sigma_{i,y} , \quad \hat{A}_y = k_1 (1 - \varepsilon) W_{i,y-1} + k_2 (1 - \varepsilon) W_{i,y-1} .$$

Pilot sluttrapport  
Effektanalyse  
Forfatter: Per Oddvar Osland



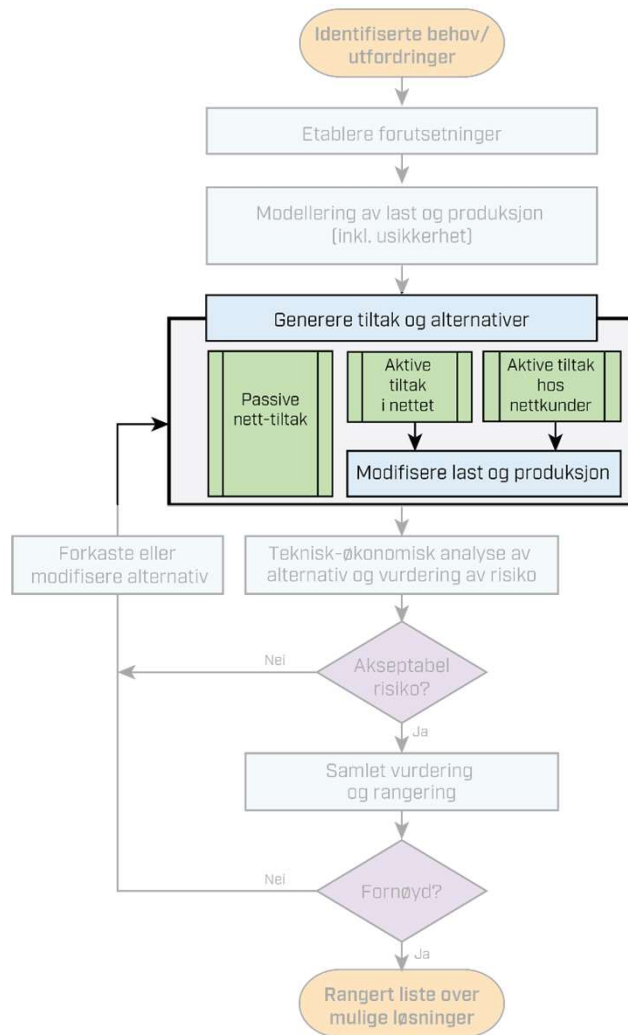
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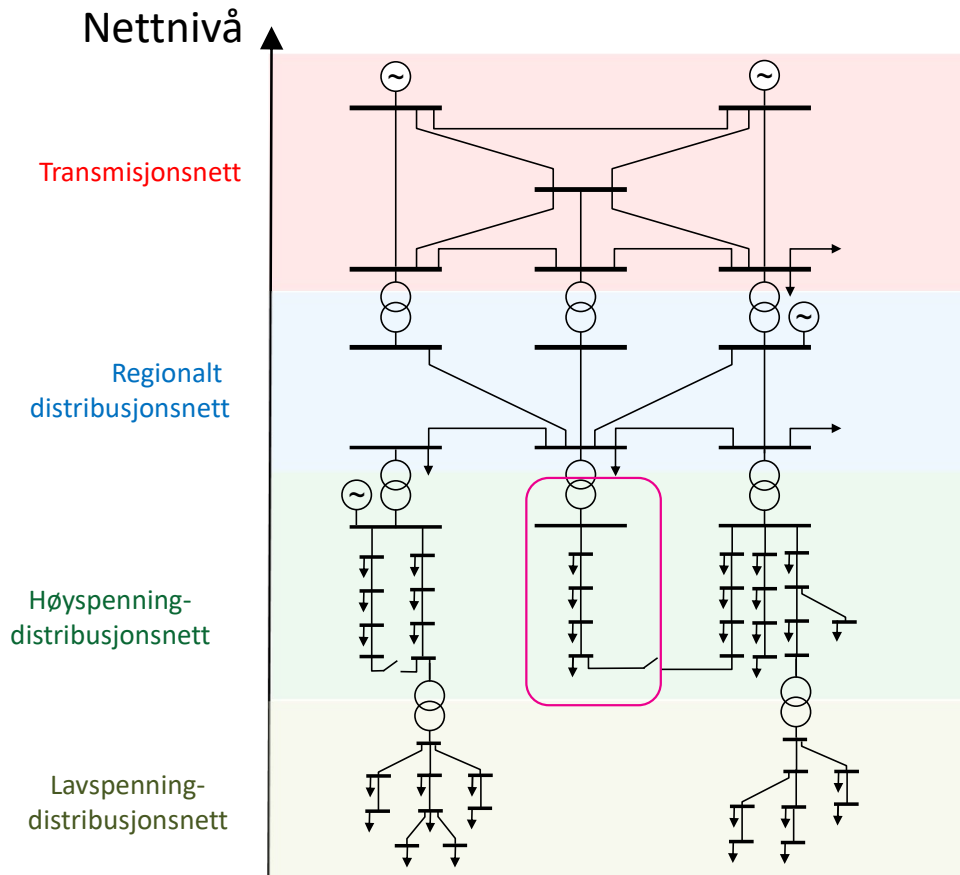


# Planleggingssystematikk for distribusjonsnett



Se også: PLAN\_ADGrid på GitLab: [https://gitlab.sintef.no/Rubi.Rana/plan\\_adgrid](https://gitlab.sintef.no/Rubi.Rana/plan_adgrid) av Rubi Rana, Iver Bakken Sperstad, Susanne Sandell og Sigurd Bjarghov © 2022-2024 SINTEF Energi AS

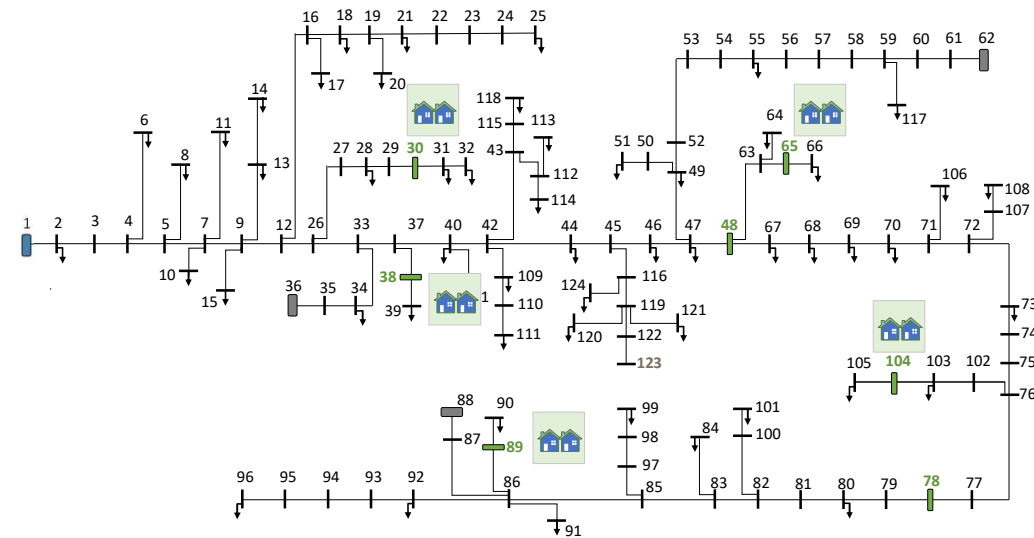
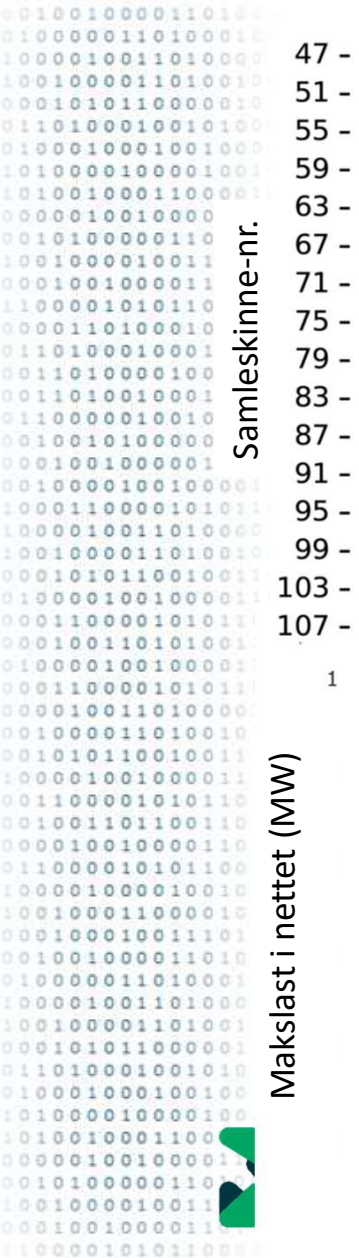
# Kraftsystemet



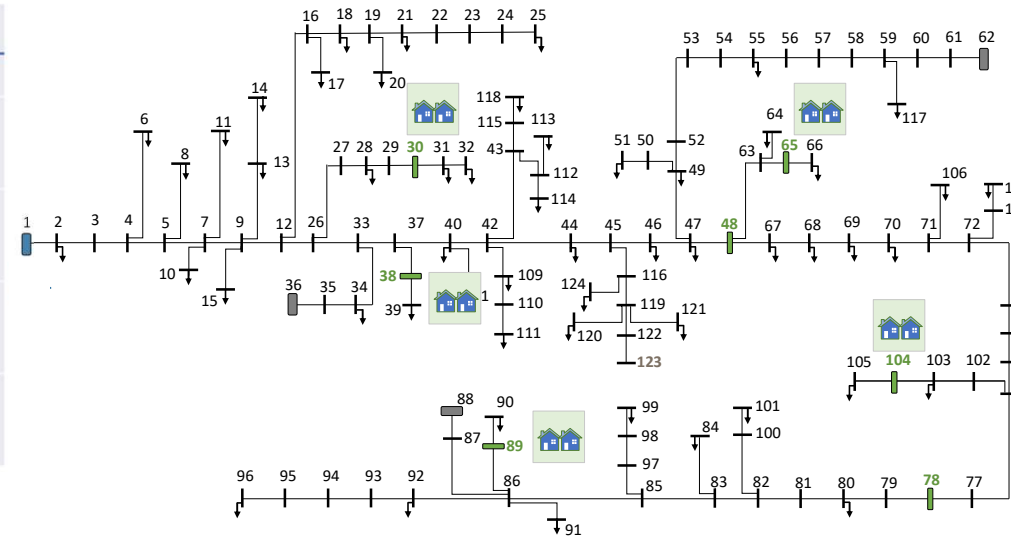
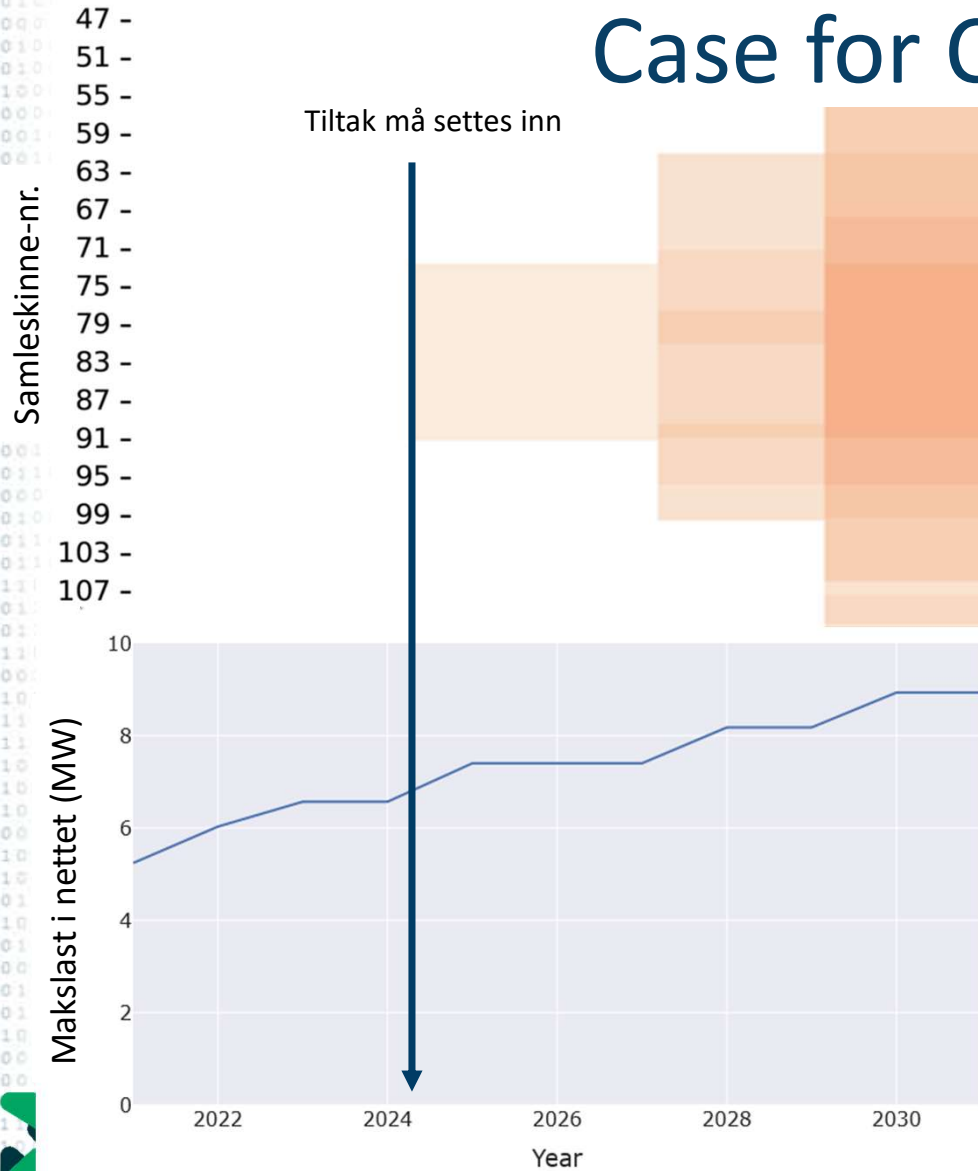
Case for CINELDI-referansenettet



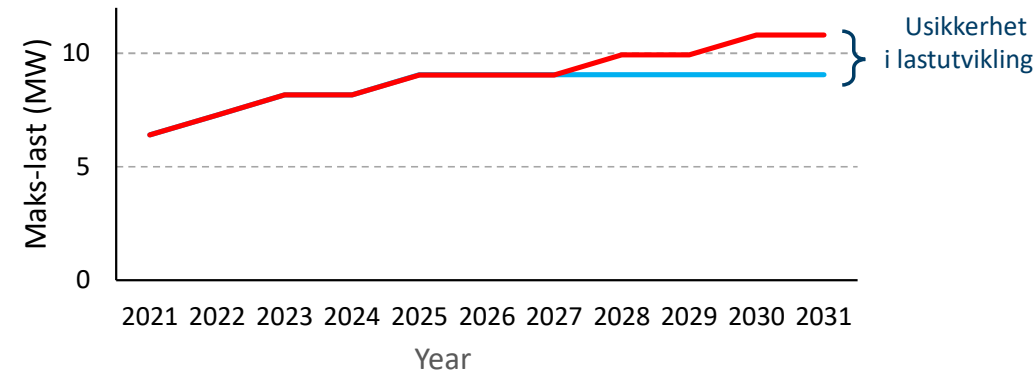
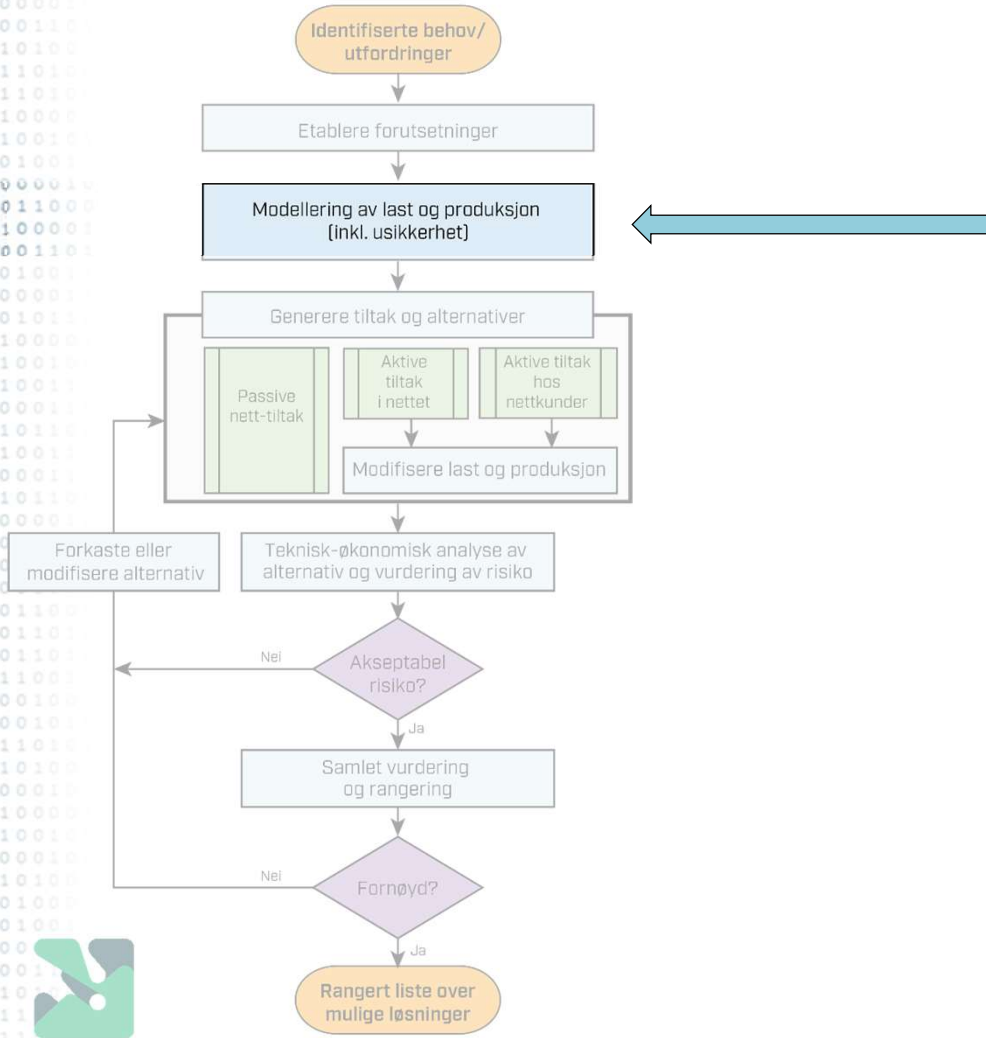
# Case for CINELDI-referansenettet



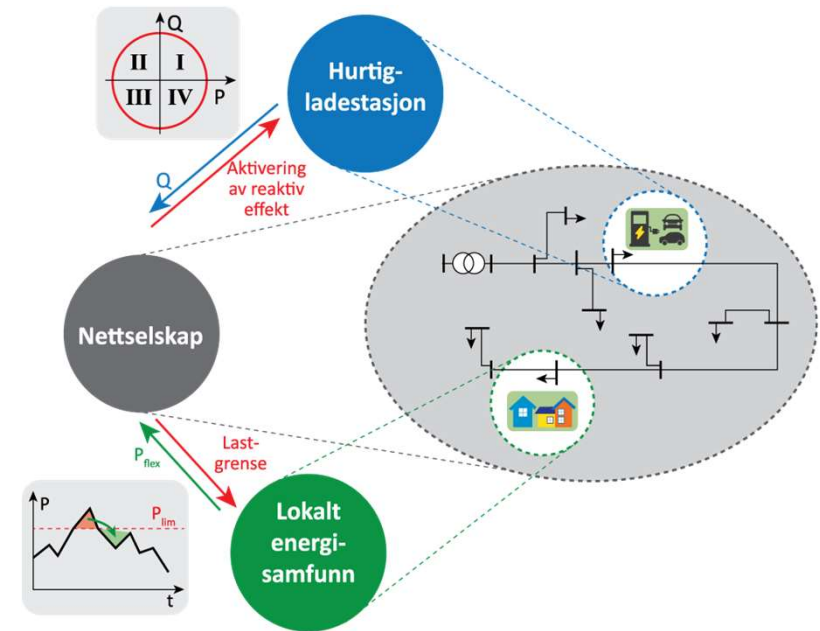
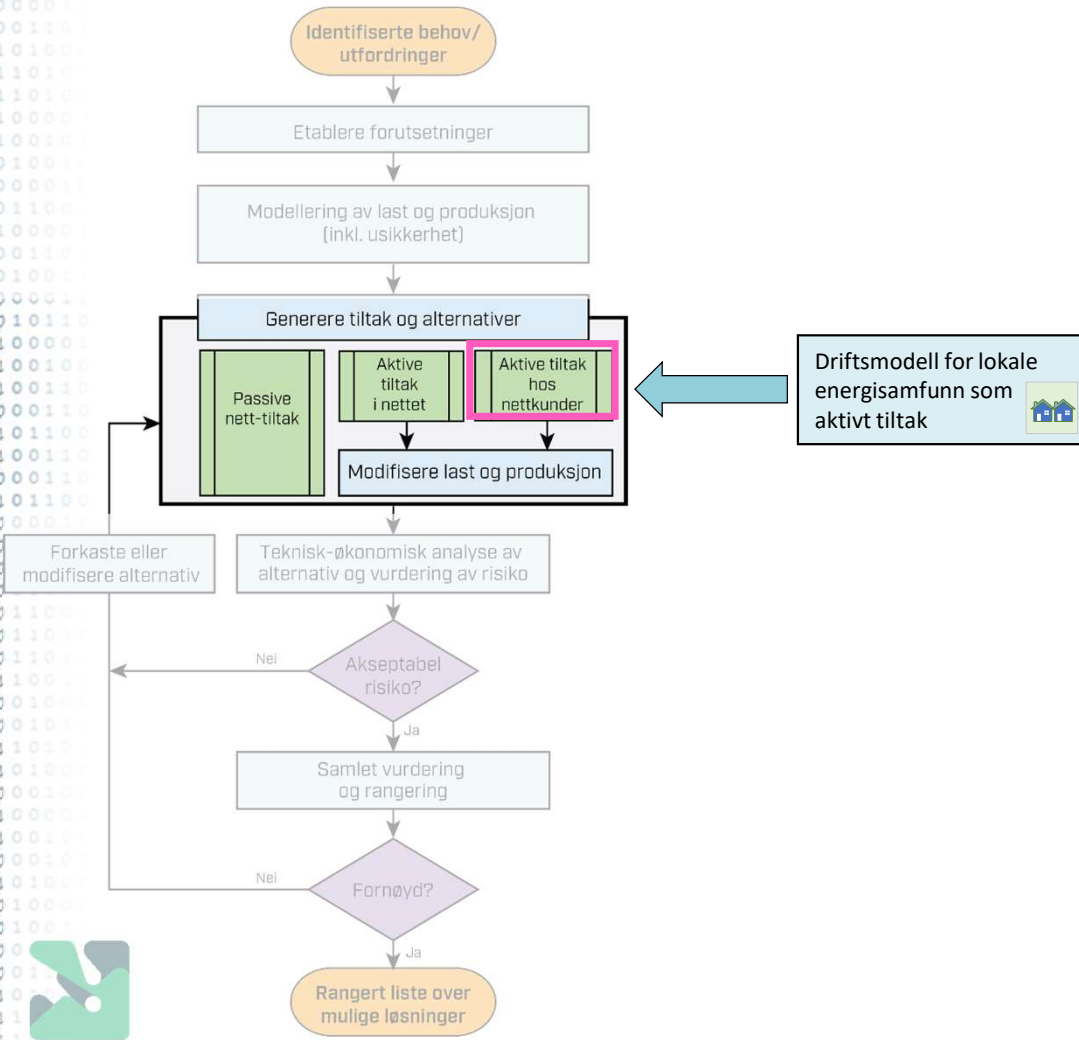
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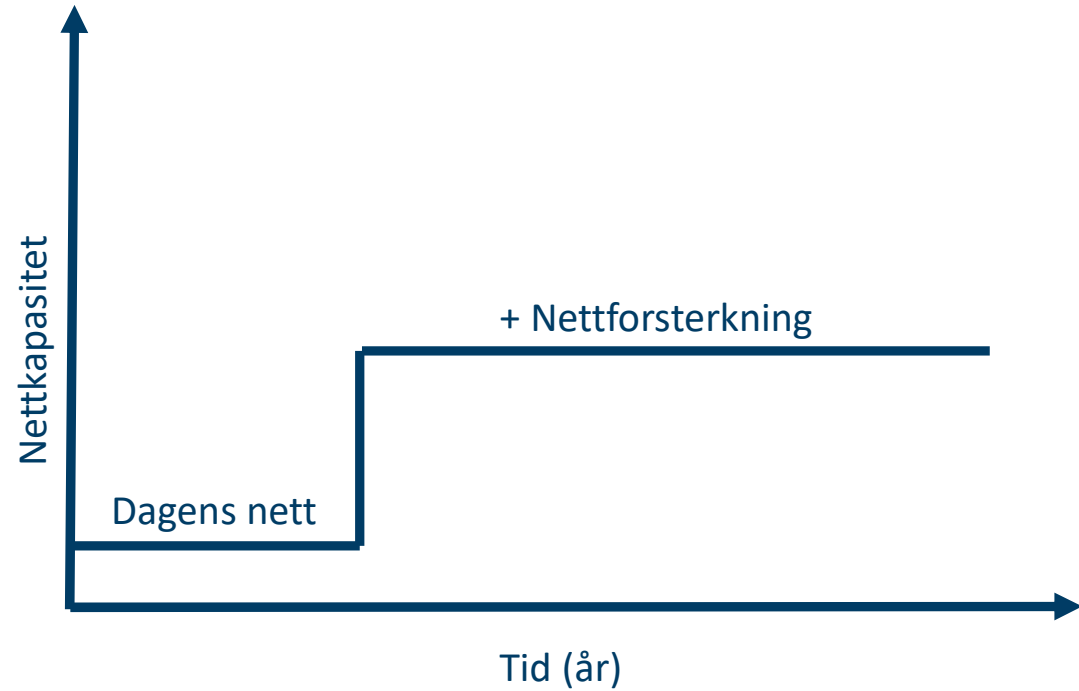
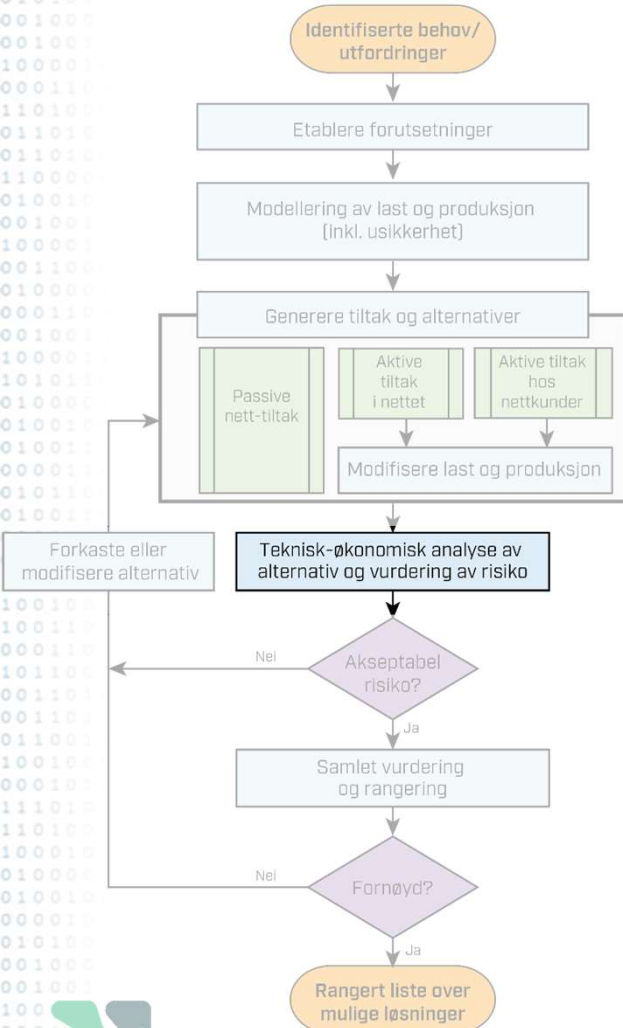
# Modellering av last (inkl. usikkerhet)



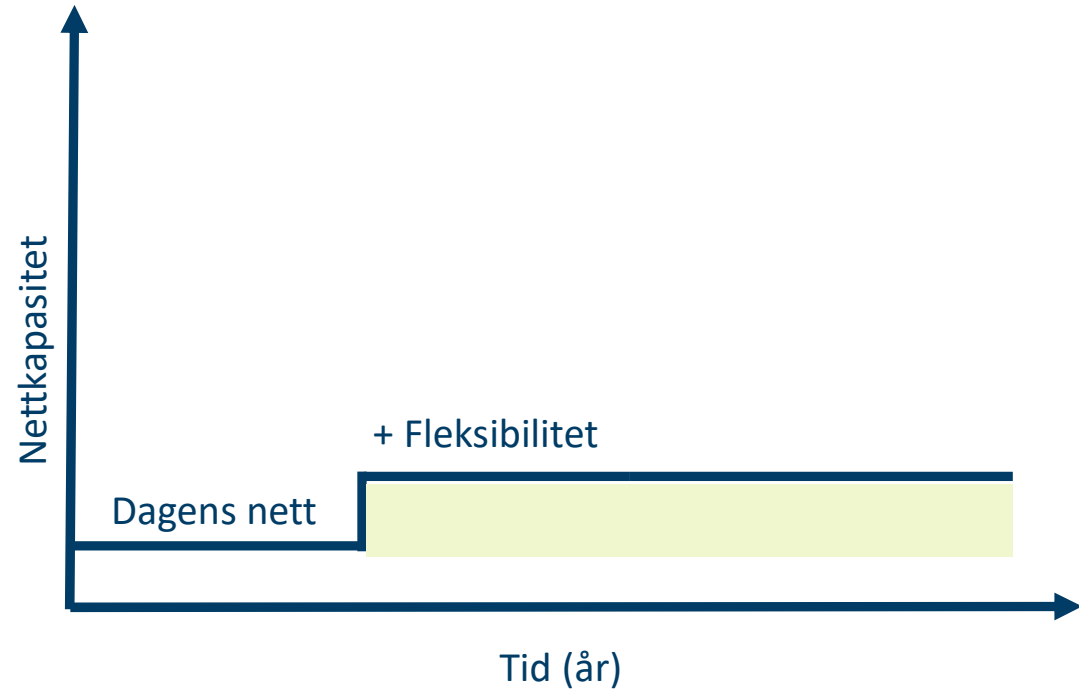
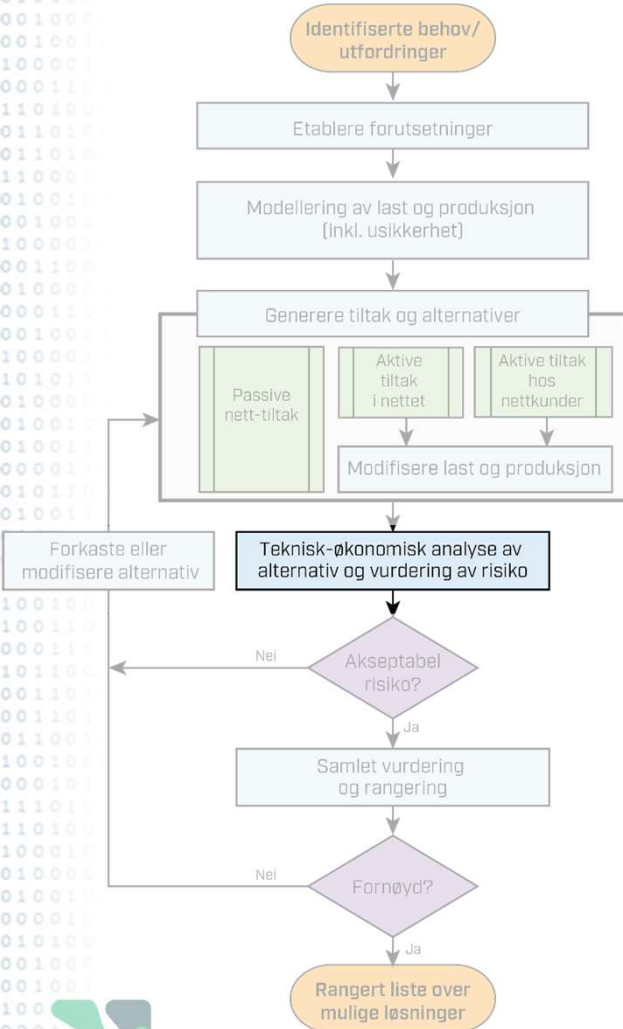
# Modellering av aktive tiltak (m. lokale energisamfunn)



# Strategi Risikoovers: Forsterk nettet

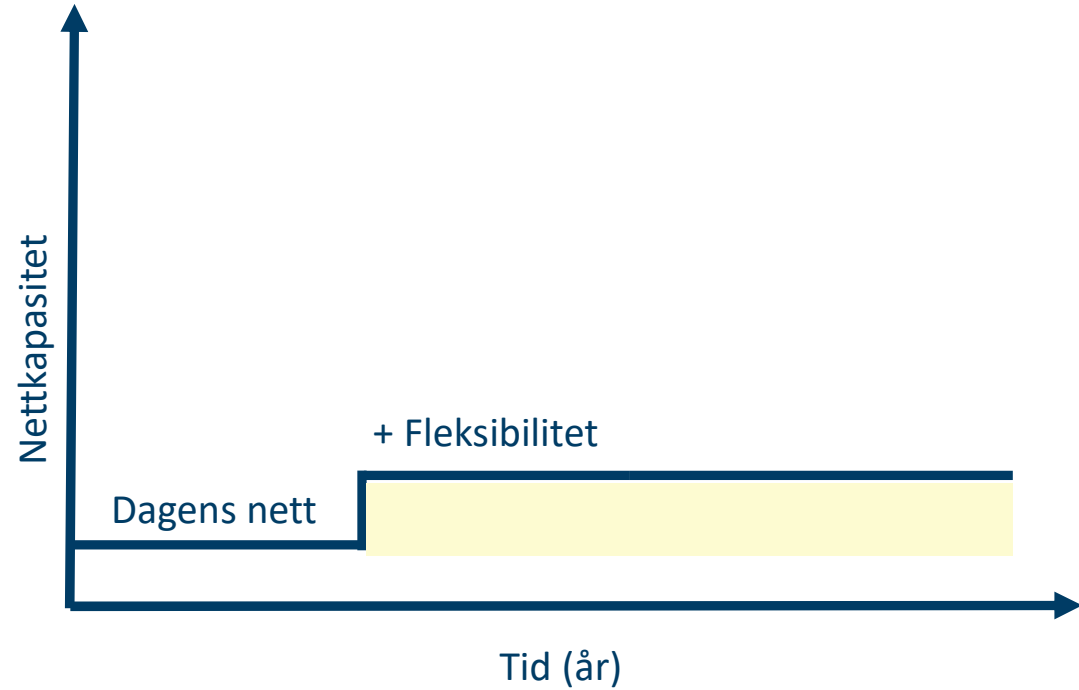
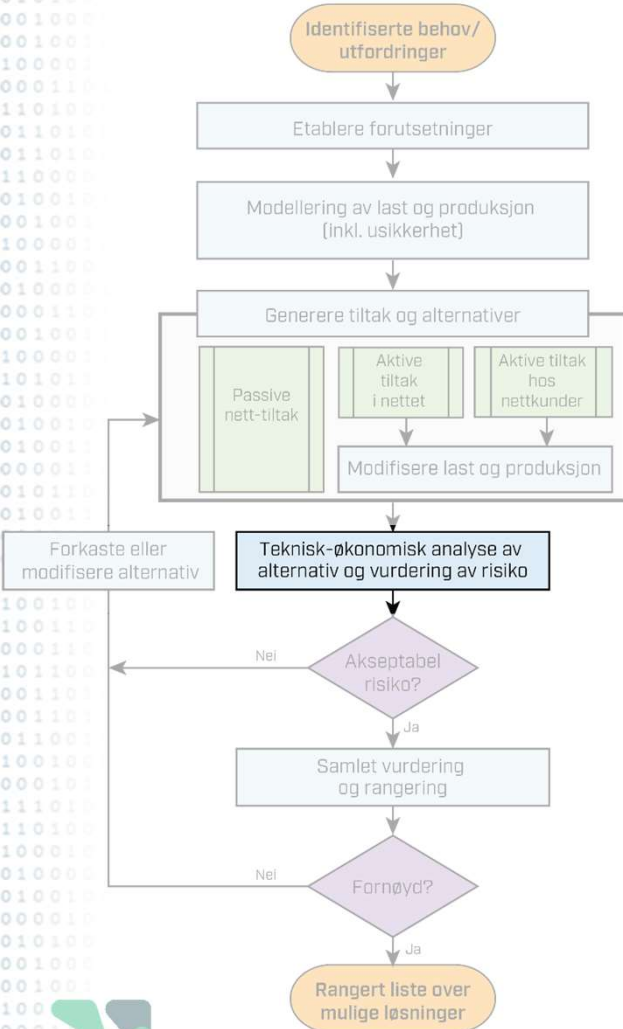


# Strategi *Risikovillig*: Vent-og-se

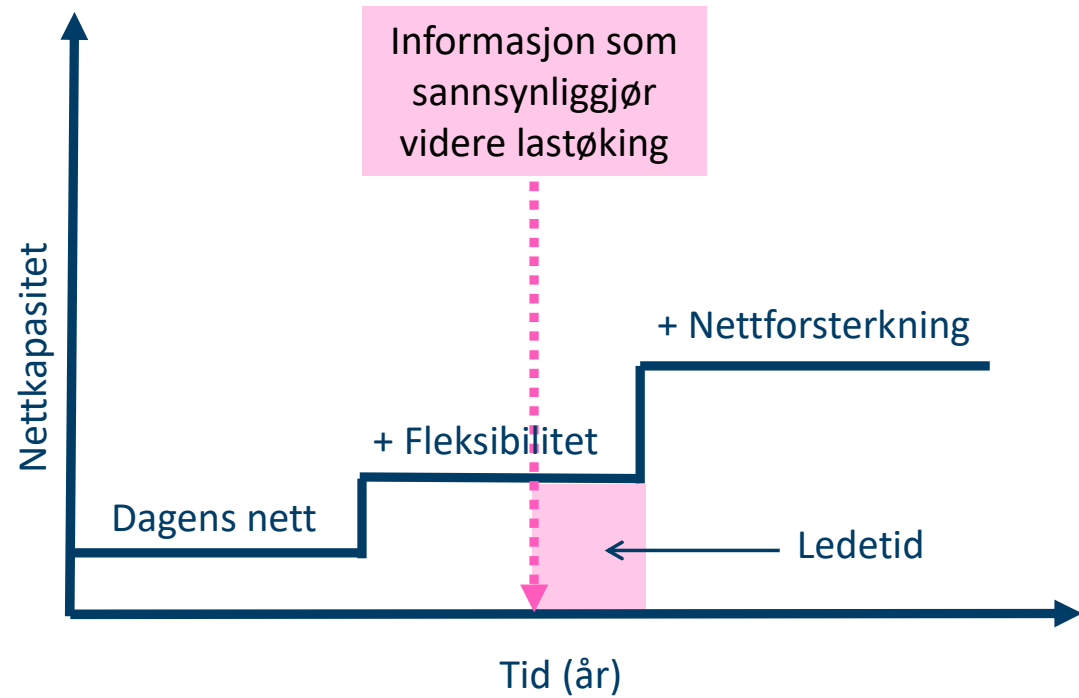
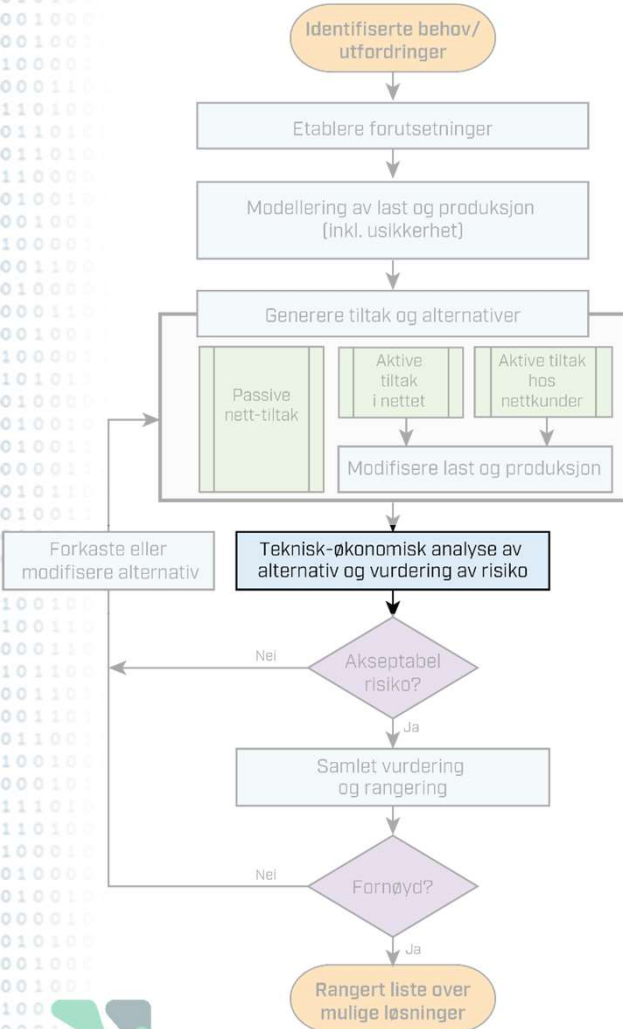




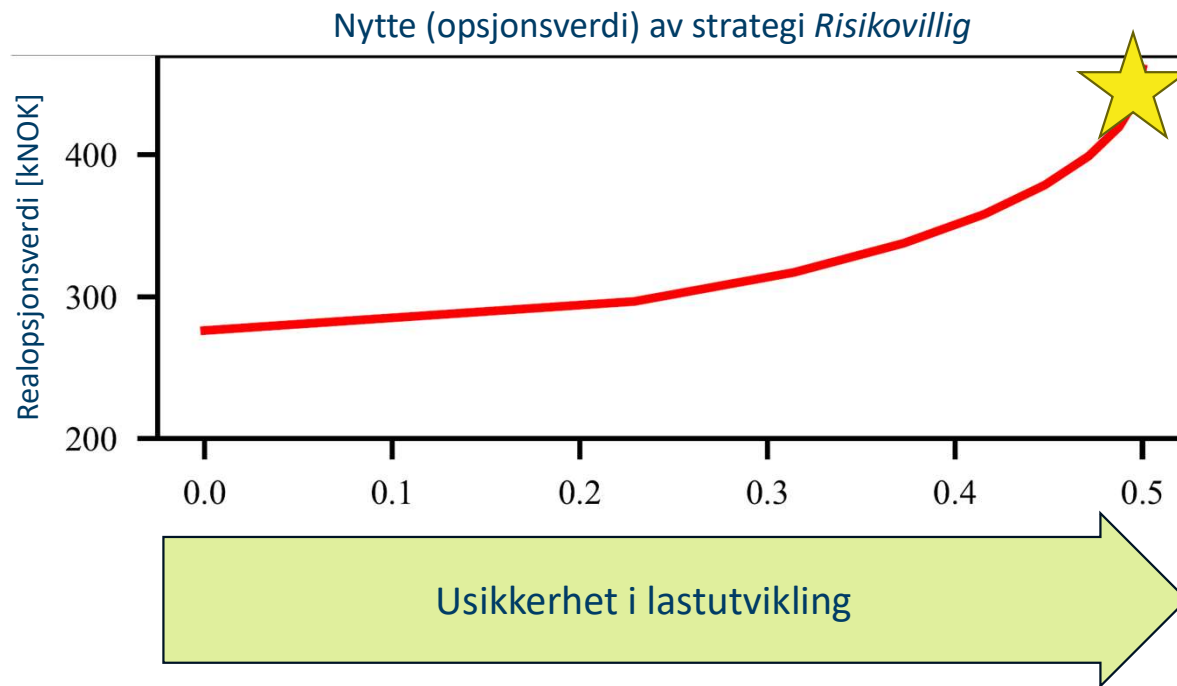
# Strategi *Risikovillig*: Vent-og-se



# Strategi *Risikovillig*: Vent-og-se



# Nytten av fleksibilitet er størst når lastutviklingen er usikker





Statistisk lastmodellering gir bedre kontroll på risikoen ved nettplanlegging



Nettplanleggingsmodellen til CINELDI foreslår strategier med ulik risikoprofil



Målet er ikke alltid å utsette nettinvesteringer – men fleksibilitet og aktive tiltak kan hjelpe med å håndtere risikoen bedre i ledetiden.

