ESOMs TO SUPPORT NATIONAL CLIMATE PLANS

THE TRANSITION TO A CLIMATE NEUTRAL ENERGY SYSTEM - PERSONAL REFLECTIONS

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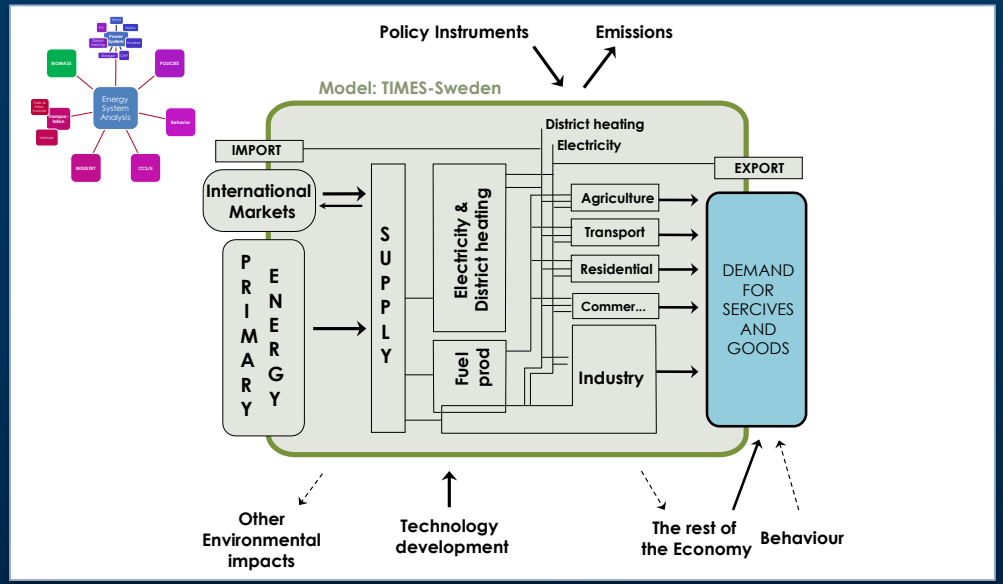
USING TIMES-SWEDEN TO MODEL: LONG-TERM ENERGY TRANSITION TO MEET THE SWEDISH CLIMATE TARGET FOR YEAR 2045



TIMES-Sweden: Developed within two EU-project (NEEDS & RES2020), and thereafter developed further to respect Swedish condition, e.g. district heating, biomass, transportation, industry, …

www.ltu.se/TIMES-Sweden

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BACKGROUND AND AIM

BACKGROUND:

- ESOM that include the comprehensive energy system, including industry processes and transportation sectors capture the significant amount of GHG. E.g. TIMES-Sweden capture 80% of all GHG, and more important the GHG for which there exist 'tangible' reduction-options.
- To explore net-zero CO2-emission scenarios options, we need to include sector interaction (=the strength of comprehensive ESOMs).
- There is many ways in how the future may unfold, we need to explore a wide set of scenarios. Optimization models can generate a large number of scenarios in a short time.

AIM: Reflect on how our TIMES models can support the policy makers in steering towards an energy transition that meet the Paris agreement.

NATIONALLY DETERMINED CONTRIBUTION (NDC)

According to the Paris agreement (UNFCC, 2015), article 4, paragraph 2, each country shall "… prepare, communicate and maintain successive nationally determined contributions that it intends to achieve. Parties shall pursue domestic mitigation measures, with the aim of achieving the objectives of such contributions".

- → The NDCs represent the efforts each country agreed upon when it comes to reducing national GHG emissions (climate mitigation) and adapting to the impacts of climate change (climate adaptation). **DOMESTIC CLIMATE TARGET(S)**
- → Each report should reflect the country's ambition for reducing emissions, with regards to its domestic circumstances and capacity. The NDCs are to be submitted every five years to the UNFCCC secretariat, with the round of NDCs being submitted by 2020. **HOW TO MEET THE TARGET(S)**

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WHICH QUESTIONS CAN THE MODEL ANSWER? - WHAT KIND OF ANALYSIS CAN ESOMs SUPPORT?

Two different kinds of analyses

1) Identifying which target(s) to aim for:
   WHICH CLIMATE TARGET(S) to commit to?
2) Analysing the energy transition to meet these targets:
   HOW can THE TARGET(S) be met?

Stand-alone ESOMs cannot assess:

- The impact on the economy from imposing different climate targets.
- The change in the demand of energy intensive services and goods due to higher energy prices (can to some extent by including demand elasticities, but still limited.

(However, the models can capture the difference in meeting a climate target from different demand projections).

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SWEDISH CLIMATE ACT

A climate policy framework & a climate and clean air strategy for Sweden entered into force Jan 2018

1. **A long-term climate goal:** By 2045 - at the latest – Sweden will have no net emissions of greenhouse gases.
2. **Intermediate targets** only for emissions outside the EU Emissions Trading System (known as the non-trading sector/NETS).
    - NETS targets for year 2030 and 2040.
    - Transport sector targets for year 2030.
3. **A clean air strategy** with a focus on reducing air pollutants (NOX, SO2, VOC, NH4 and particles) and thereby improved air quality.

Net-zero means 15% of reduction can be offset by: i)LULUCF, ii)abroad, iii)BECCS

POLICY QUESTION: HOW CAN THE TARGET(S) BE MET?

WHICH QUESTIONS SHOULD THE MODEL ANSWER?

- Are 'current policies in place' sufficient to reach the climate target? If not, how far does they take us? And which emissions remains?
- **What** measures (policies and/or actions) are needed **Where** (in which sectors) and **When** (in time)?

→ Which scenarios?

→ Which kind of results?

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SCENARIO ANALYIS ≈ "RISK ASSESSMENT"
NOT PREDICTING THE FUTURE, BUT LOOKING AT DIFFERENT WAYS ON HOW THE FUTURE MAY UNFOLD UNDER DIFFERENT CONDITIONS

SCENARIO ANALYSIS

1) POLICY: Compare the impact from different policies, e.g.
   - CO2-tax level
   - A new scheme on transportation fuel
   - Climate target

2) FUTURE UNCERTAINTY: Capture that the future can unfold in different ways, e.g.
   - PRICES: e.g. future oil and gas prices
   - ENERGY SOURCES: e.g. biomass pot per fraction (compete with non-energy use)
   - DEMAND PROJECTIONS: e.g. how people transport themselves = demand
   - TECHNOLOGY DEVELOPMENT: Assumptions on when technology will be available – to what cost and with which efficiency

SENSITIVITY ANALYSIS

- Techno-economic assumptions
- Further demand projections
- Discount rate
- Energy resources
- …..

SCENARIOS: UNCERTAINTY IN HOW THE FUTURE MAY UNFOLD (IN THIS CASE DEMAND AND PRICES PROJECTIONS)

	2. Transportarbete efterfrågan			3. Car fleet			7. Fossil fuel prices (imp/export priser)			8. Forest based Biomassa (potential of residuals)	
Scenario	REF: Transport demand in line with official projections (Swedish EPA & Energy agency, 2017)	Extrem-WC: Scenario 'Basprognos' from Trafikverket (2018)	Extrem-BC: Scenario 'Transporteffektivare samhälle' from ÅF (2018)	Modeled endogenously by the model.	Exogenously given for year 2030, according to BM scenario in (Algers, 2017)	Exogenously given for year 2030, according to BM-techup scenario in (Algers, 2017)	High = "Current policies" in table 4 in IEA (2017)	Ref = "New Policies" in table 4 in IEA (2017)	Low = "Sustainable development" in table 4 in IEA (2017)	Ref (High production/harvesting)	Low (Low production/harvesting)
Baseline	X			X				X		X	
Extrem - WC		X		X					X	X	
Extrem - BC			X	X			X				X
Bio 1	X			X				X		X	
Bio 2	X			X				X		X	
Vehicle 1	X			X				X		X	
Vehicle 2	X				X			X		X	
Vehicle 3	X					X		X		X	

SCENARIOS: COMPARE THE IMPACT FROM DIFFERENT POLICIES

Scenario	5. Policy: FF-Reduction obligation system ("Reduktionsplikt")					
	Separate systems for diesel and gasoline	Joint systems for diesel and gasoline	**Only inlc. biofuels in diesel- & gasolin-pumps**	Include all biofuels for road transporations	Target in 2030 (%)	Biogas included in the system
Baseline scenario	X	-	X		40	
Extrem-WC	X	-	X		40	
Extrem-BC	X	-	X		40	
Bio 1	X	-	X		30	
Bio 2	X	-		X	40	
Vehicle 1	X	-	X		40	
Vehicle 2	X	-	X		40	
Vehicle 3	X	-	X		40	

HOW TO GET TO NET-ZERO CO2-EMISSIONS?

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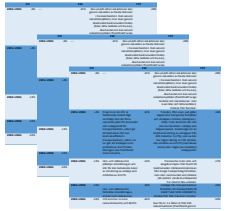
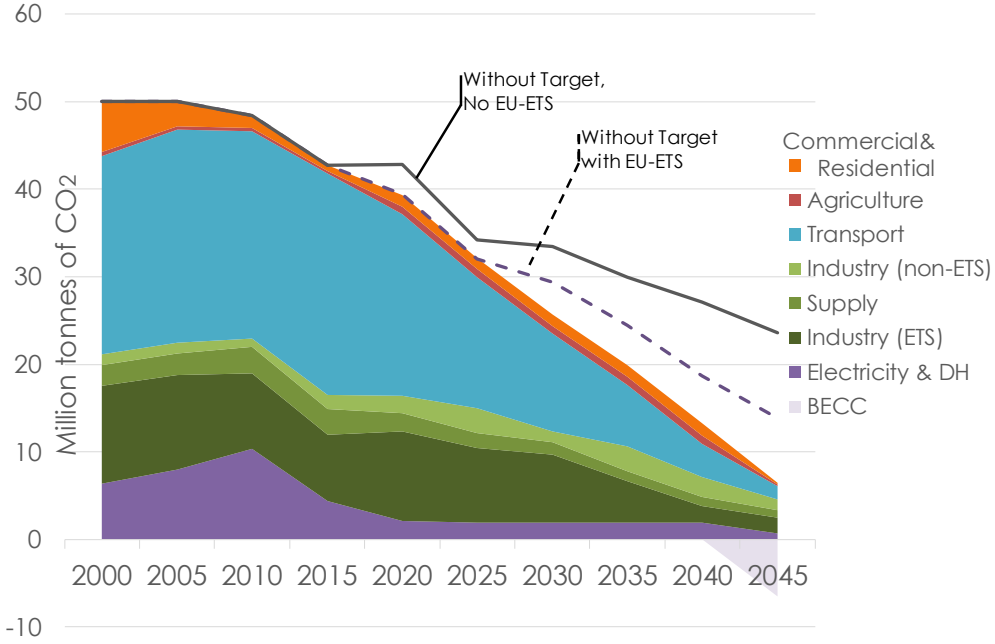
How to get to net-zero CO2-emissions?
WHEN to do WHAT - WHERE





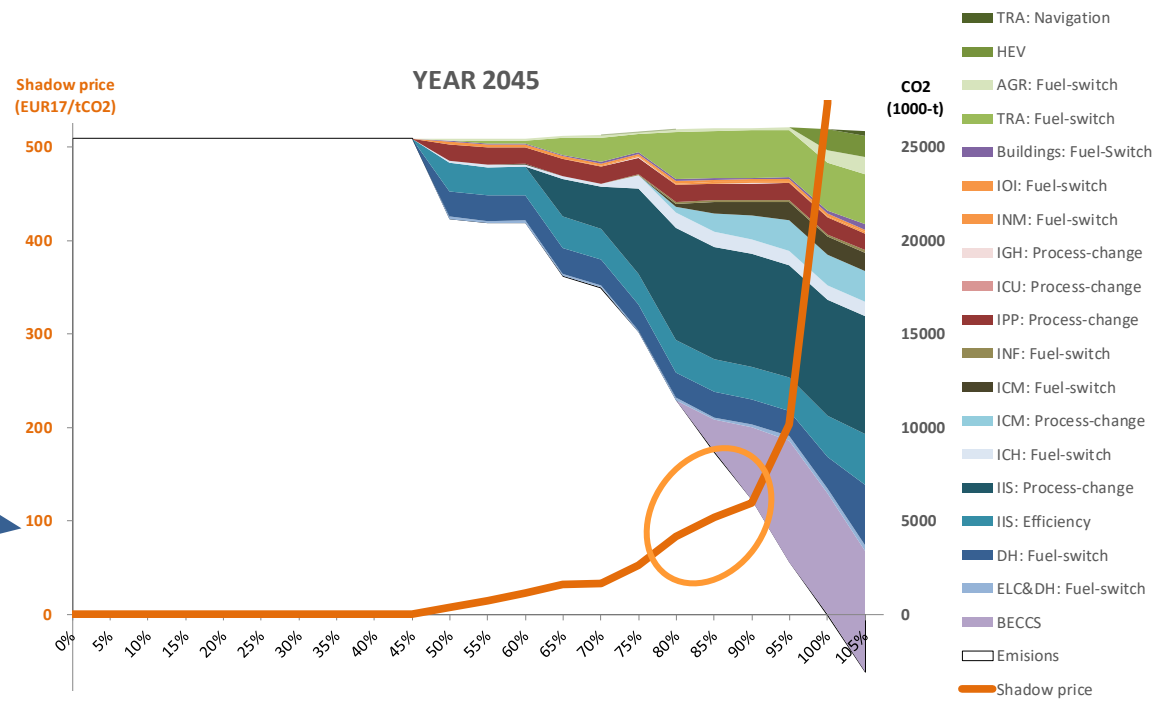
1) Are current policies in place sufficient to reach the climate target?
NO
2) If not, how far does they take us?
Present Swedish policies without EU-ETS will take us to the black line.
Present Swedish policies with EU ETS and assumed prices in EU-ETS will take us to the dotted line, but not all the way.
3) And which emissions reductions remains?
Go into the details of the model…

CO2-price to meet different reduction targets

We want to get a ”MAC”-curve

“MAC-curves” are not as static as the “McKinsey-curves” indicate

A dynamic “MAC-curves”



Scenario analysis to the Swedish Environmental Protection agency (Naturvårdsverket)

ANALYSING THE TRANSITION TO A SUSTAINABLE AND CLIMATE NEUTRAL ENERGY SYSTEM – FINAL REMARKS

- Need to include sector interaction → the strength of ESOMs
- There is many ways in how the future may unfold → need to explore a wide set of scenarios. Optimization models can generate a large number of scenarios in a short time.
- Nevertheless, each scenarios have an excessive amount of result parameters → critical to identify which (of all) results to analyze further → takes time and require experience. The devil is in the details!
- Critical to identify "useful" result indicators for the decision makers. This is the expertise of the decision makers.

→ **Create more platforms for dialogue between decision-makers and energy system modelers**

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TACK FÖR MIG
THANK YOU

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