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Sustainability assessment of electro-mobility transition

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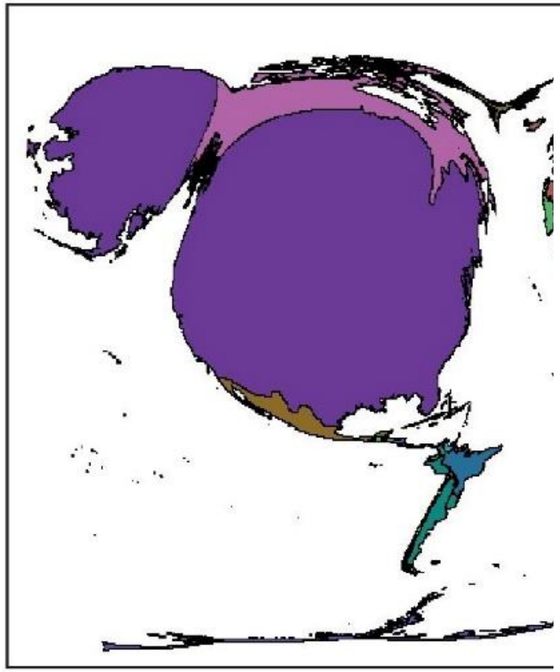
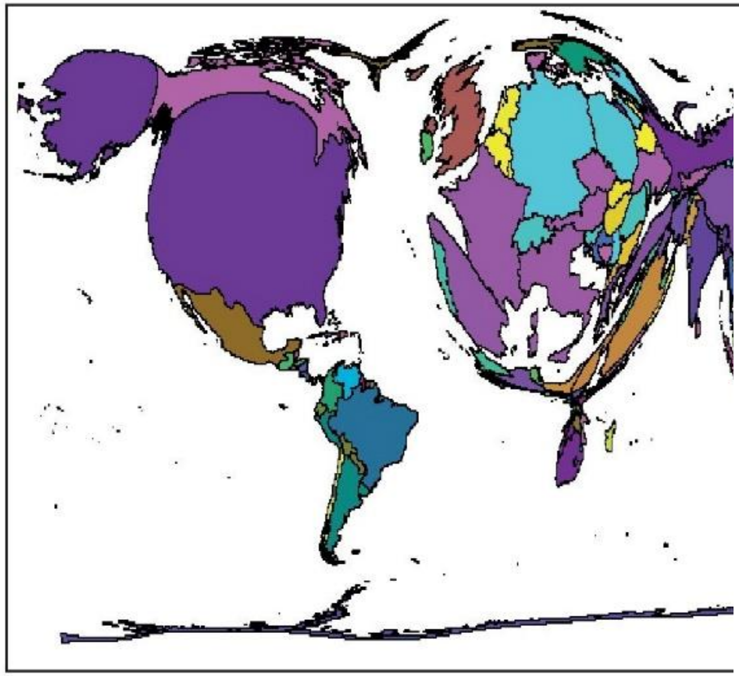
World Automobile Fleet 1960-2030

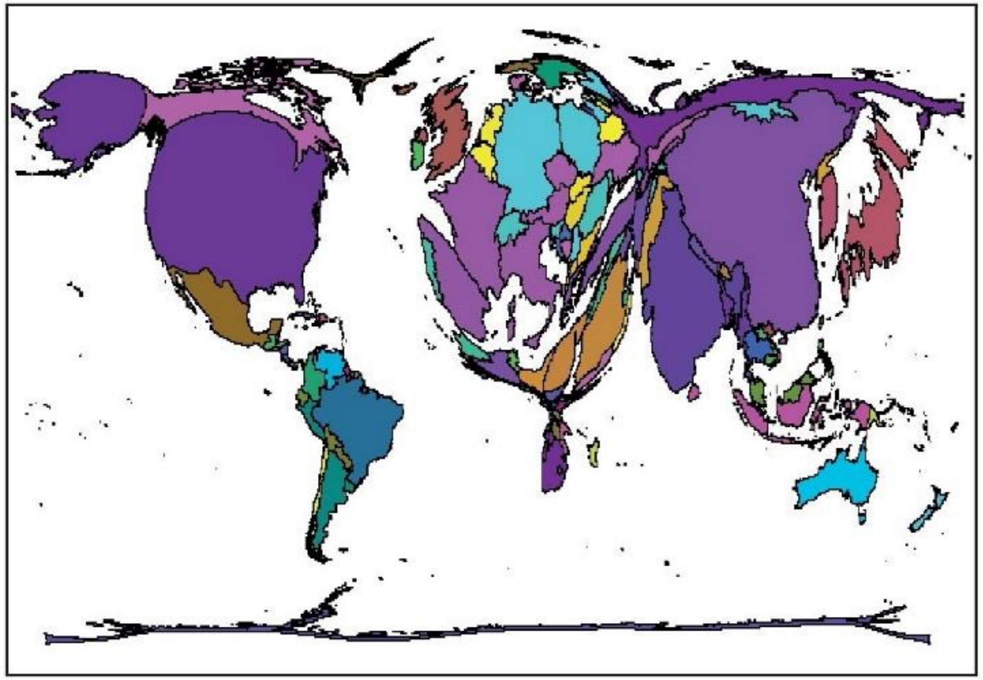
World automobile fleet in 1960, according to the UN: About 86 million



World automobile fleet in 2004, according to the UN: About 620 million



World automobile fleet in 2030, IFP simulation: About 1.3 billion

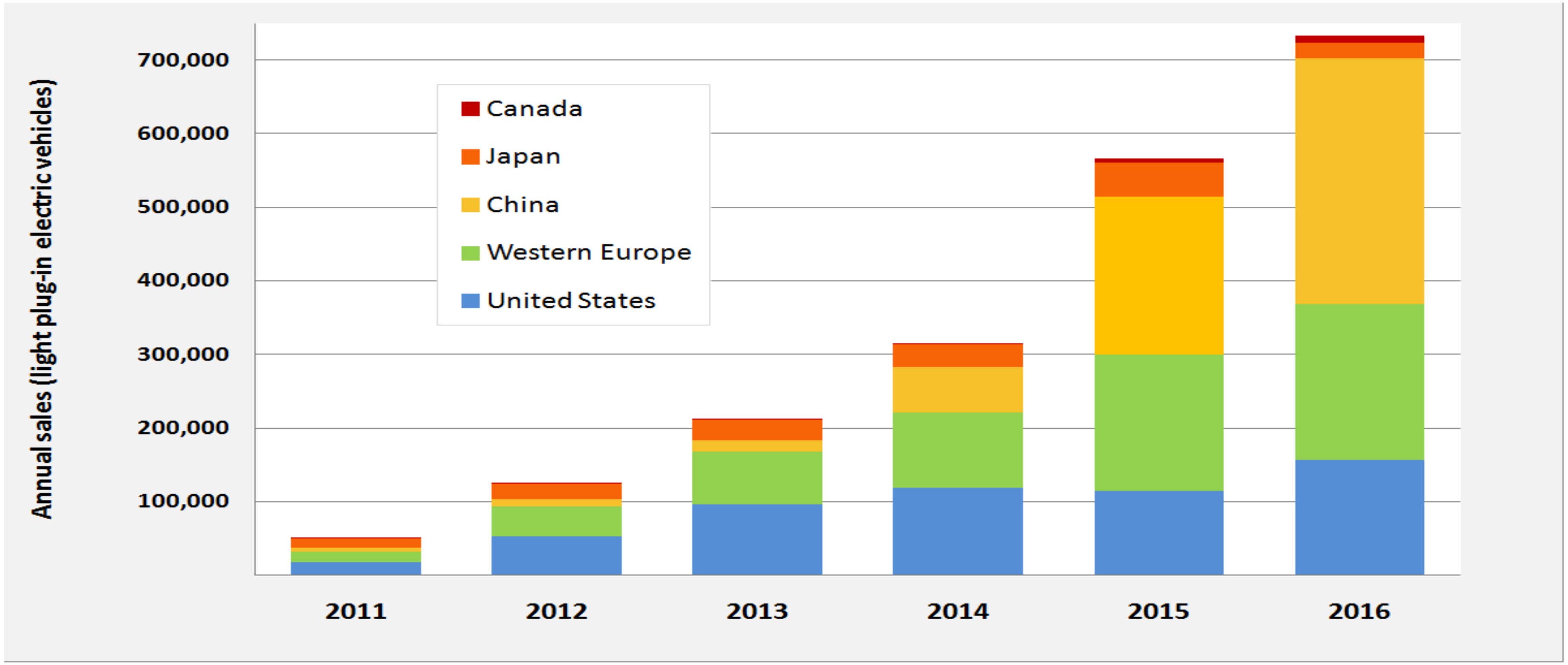


Electro-mobility

Why Electric Cars?

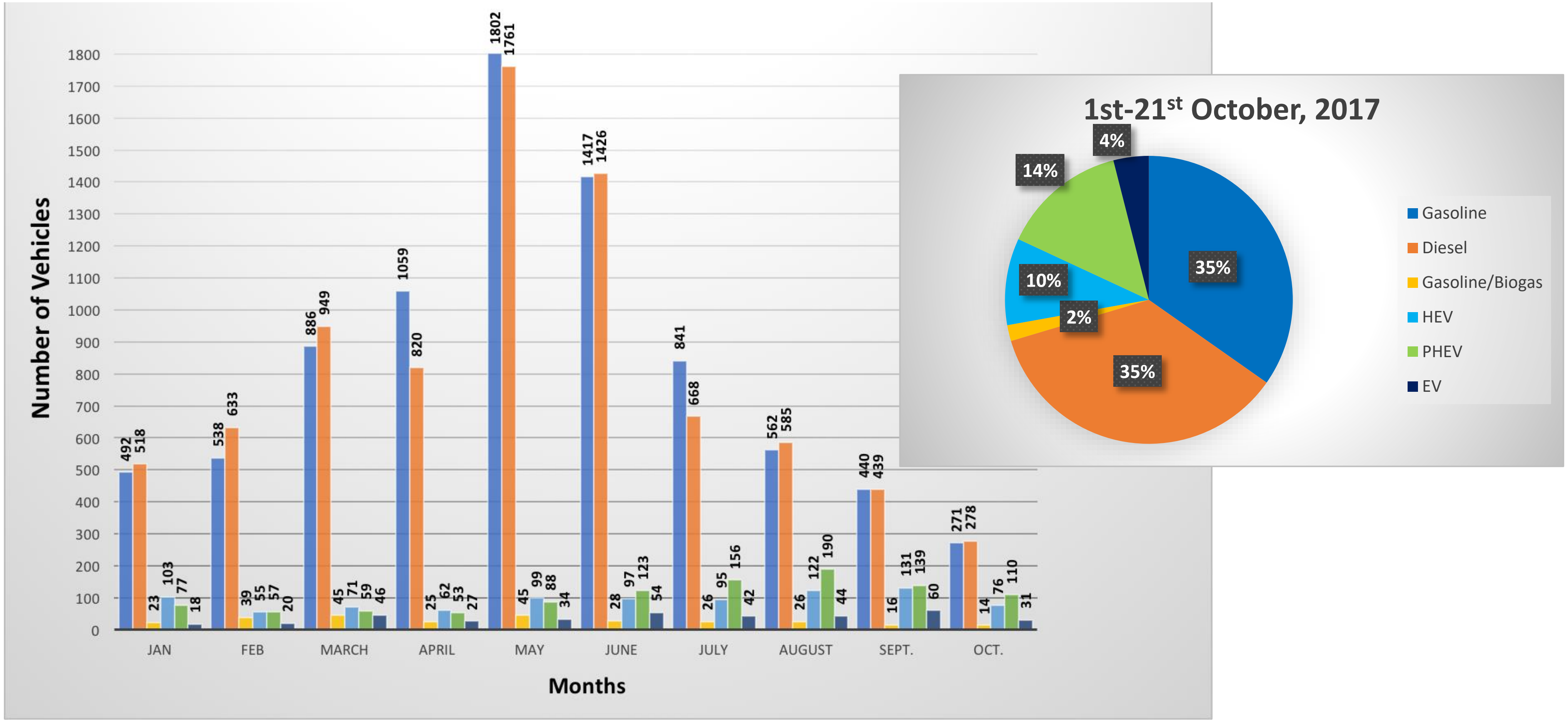
http://greenliving4live.com/2013/07/several-benefits-of-electric-cars/

Global Annual sales of Light-duty Plug-in electric vehicles in top selling markets



Data compiled by Argonne National Laboratory, Argonne, US Department of Energy, February 2016.2016: Data compiled by HybridCars.com

Monthly registration of new LDVs by powertrain in Iceland in 2017



Primary Objectives of the Study

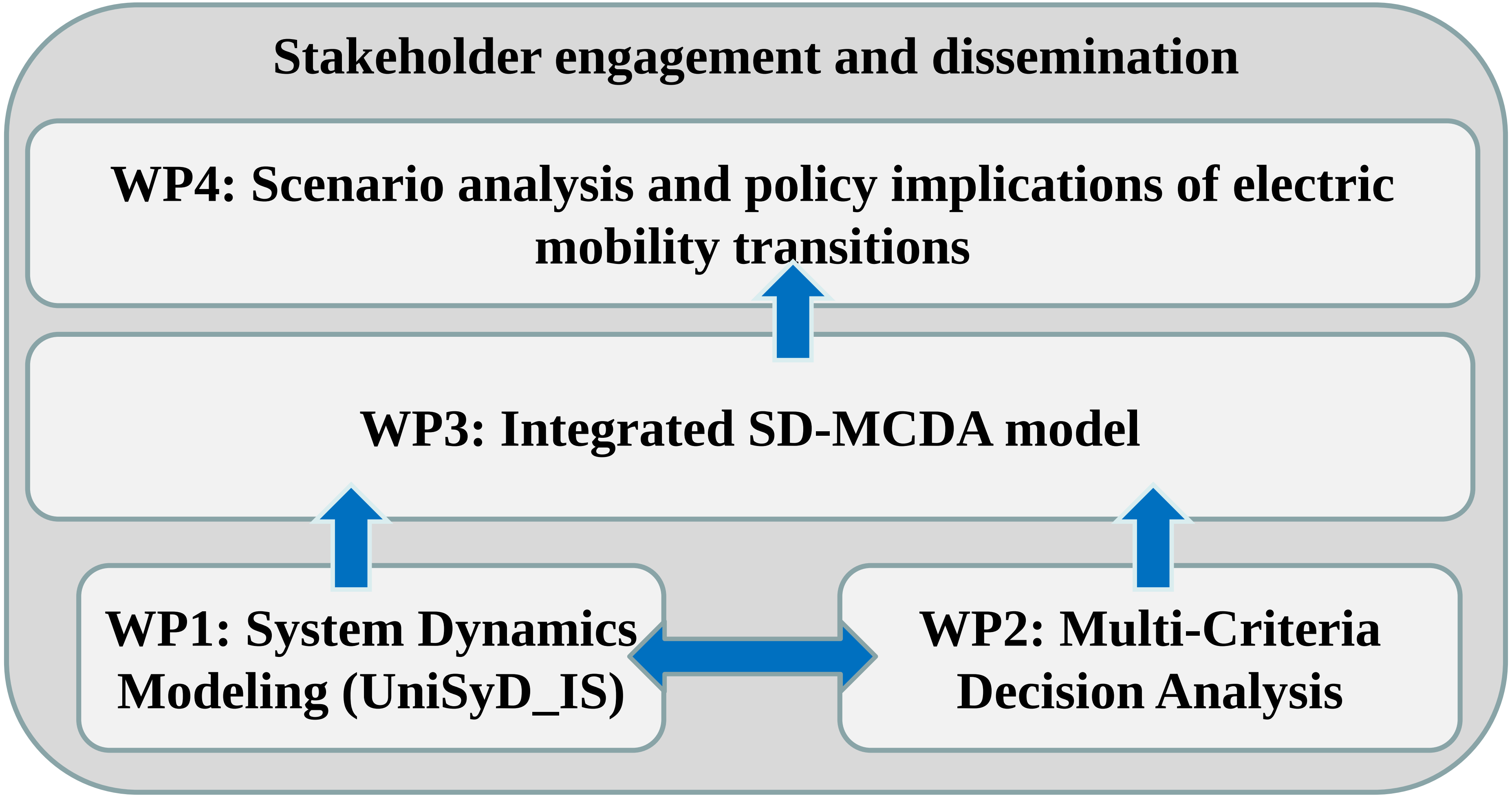
1) develop scenarios to characterize multiple electro-mobility transitions in Iceland (for example, electric rental cars, electric bus, electric taxi service.)

2) enrich the understanding of the multidimensional implications of electro-mobility transitions on the supply and demand sides of the energy system in Iceland.

3) assess the effectiveness of energy policies on electro-mobility development in Iceland

4) integrate two approaches of system dynamics and MCDA that enable multi-perspective evaluation of electro-mobility transitions.

Decision Support Framework



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nord-star*

System-Dynamics Model of Iceland’s Energy System (UniSyD_IS)

Funded by Nordforsk
as part of NORD-STAR

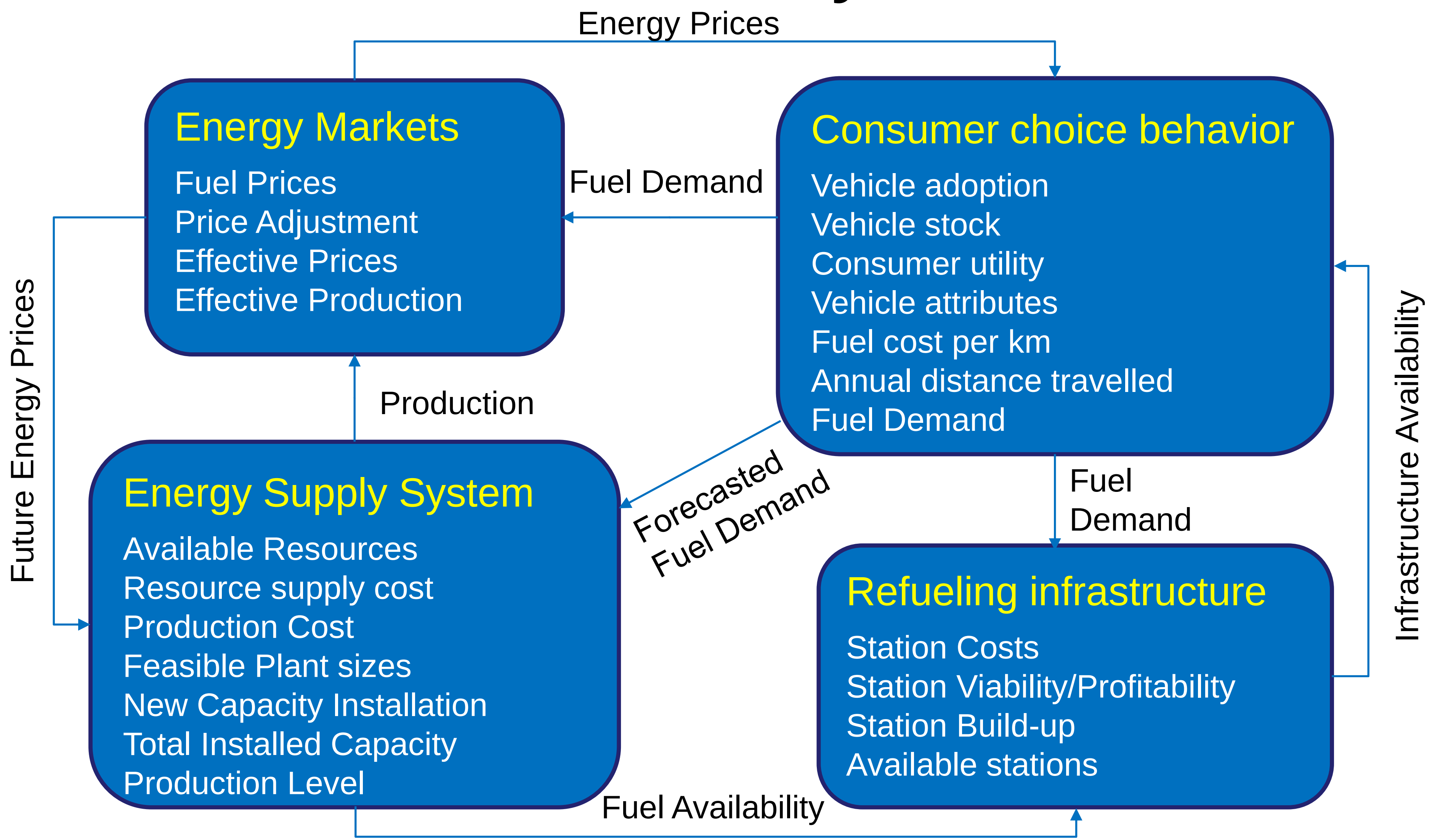
Research team in Iceland:
Brynhildur Davidsdottir (UoI), Ehsan Shafiei (UoI),
Hlynur Stefansson (RU), Eyjolfur Ingi Asgeirsson (RU), Reza Fazeli (UoI)

UniSyD_IS Model

UniSyD_IS model for analysis of transition towards alternative fuel markets:

- partial equilibrium techno-economic system-dynamics model
- detailed resource and technology specific

Modules and Key Variables



Fiscal Policies to Promote Electro-mobility

- Direct subsidies
- Feebate (Fee + Rebate)
- Petroleum excise tax
- Carbon tax

Policy Scenarios

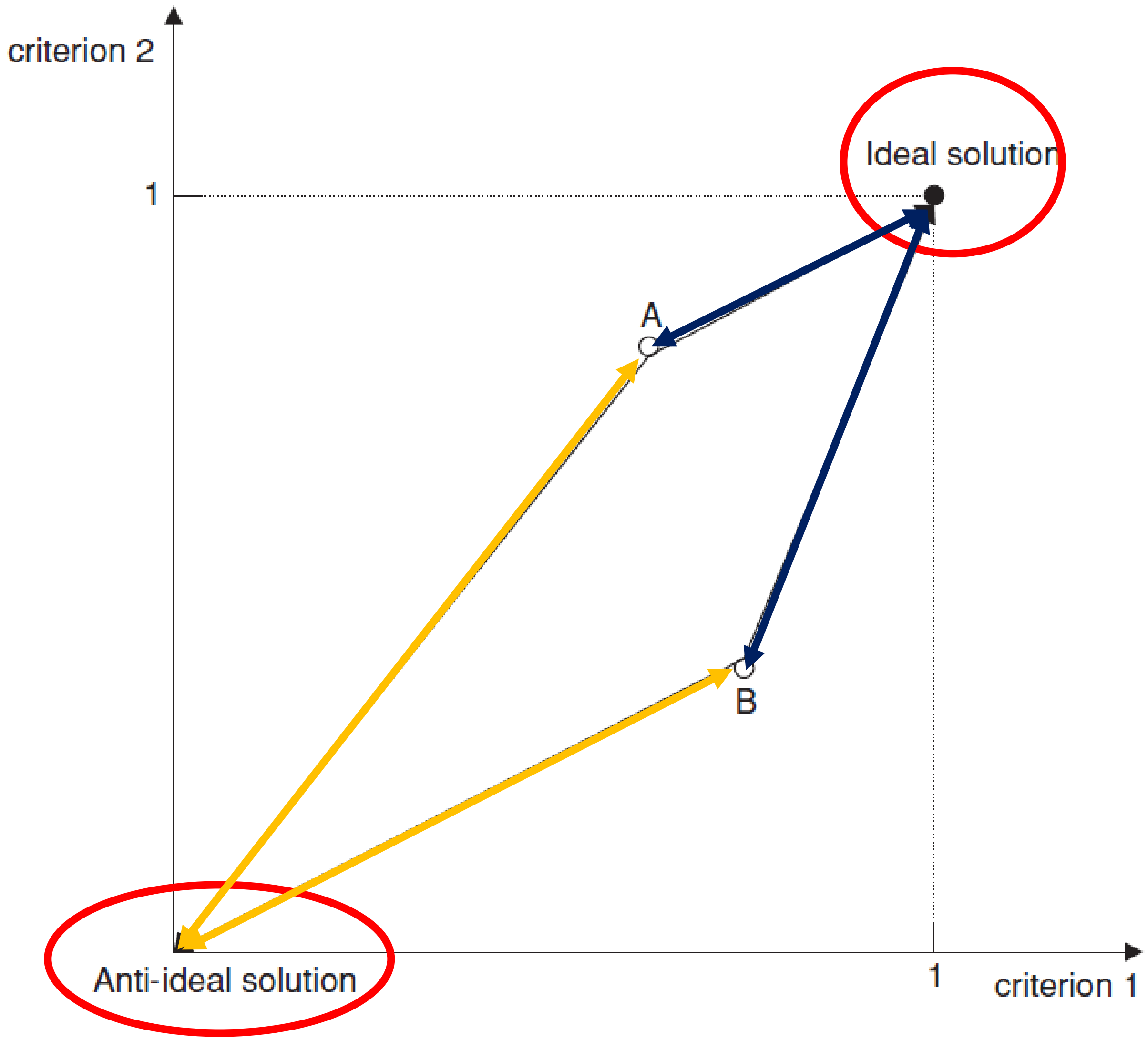
Scenarios	taxes on fuels	taxes on vehicles	incentives and subsidies
BAU	current fuel tax constant carbon tax of $20/t	Current VAT & excise duty tax levies	Current VAT exemption for EVs
BAU+Tax	BAU assumptions + 100% rise in petrol excise tax+ carbon tax rise to $200/t by 2050	identical to BAU	identical to BAU
Subsidy	identical to BAU	identical to BAU	BAU assumption + price subsidy of 20% for BEV & PHEV within both LDV & HDV fleets
Subsidy+Tax	identical to BAU+Tax	identical to BAU	identical to Subsidy
Feebate	identical to BAU	BAU assumption+ purchase fee for ICEV & HEV equivalent to 20% of conventional ICEV price	BAU assumption + price subsidy for light-BEV & heavy-PHEV equivalent to 20% of conventional ICEV price
Feebate+Tax	identical to BAU+Tax	identical to BAU	identical to Feebate

Multi-Criteria Decision Analysis

- TOPSIS Stands for “Technique of Order Preference Similarity to the Ideal Solution”.

- The fundamental idea: The best solution has shortest distance to the ideal solution and furthest distance from the anti-ideal solution

TOPSIS Method



Selection of Decision Criteria

- Government concerns:
  - Government Revenue
  - Energy Security
- Public concerns:
  - Consumer costs
  - Environmental impacts (GHG mitigation)

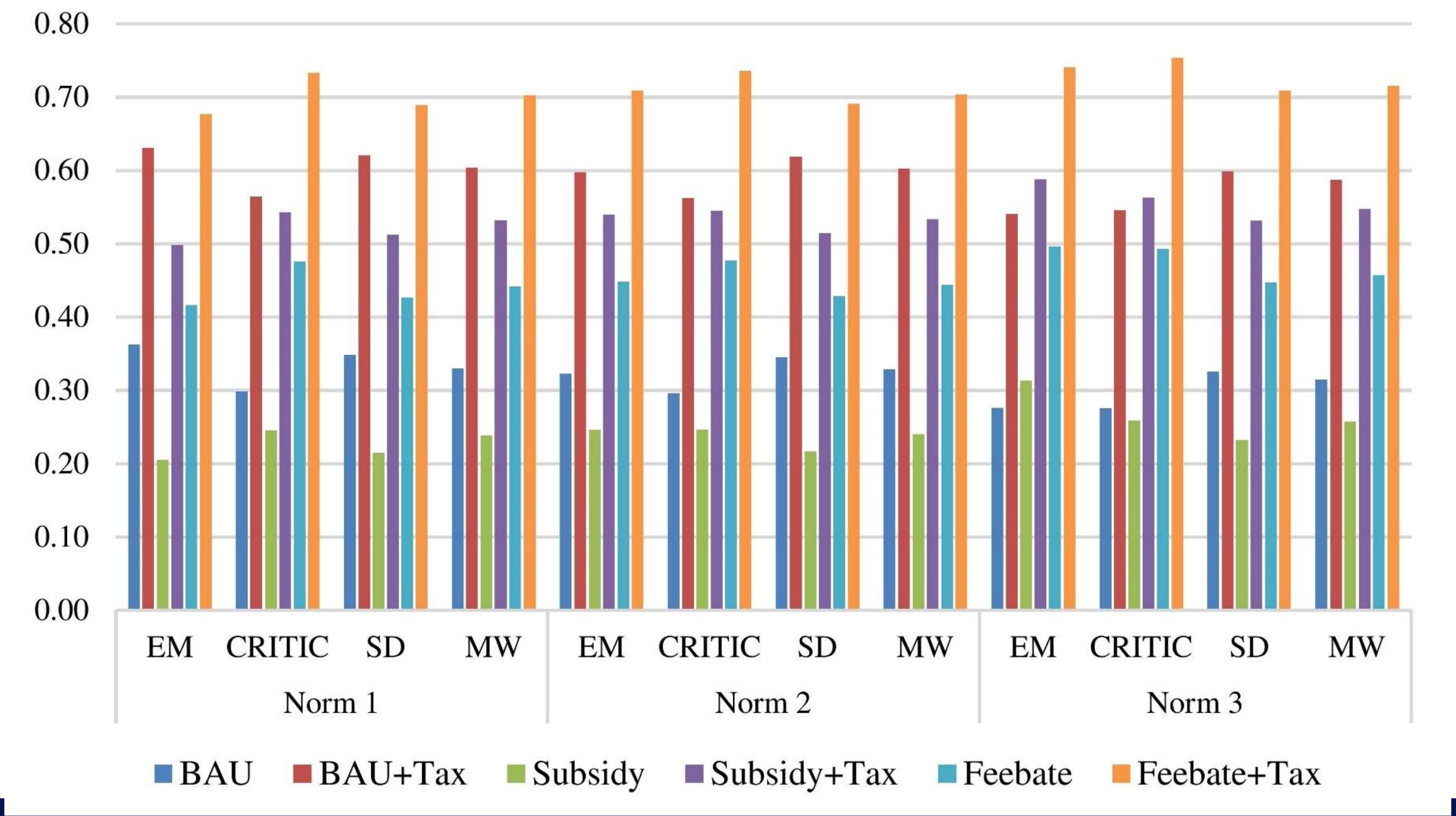
Decision Matrix

	Government revenue (M$)	Consumer cost (B$)	GHG mitigation potential (%)	Energy security (%)
BAU	**498.2**	**2.6**	**0%**	**11%**
BAU+Tax	**674.0**	**2.7**	21%	14%
Subsidy	**290.0**	**2.4**	**9%**	15%
Subsidy+Tax	444.9	2.5	**28%**	**18%**
Feebate	**368.5**	2.5	18%	**19%**
Feebate+Tax	492.2	2.6	**35%**	**23%**

Objective weights

Measurement method	Government Revenue	Consumer Cost	GHG Emissions	Energy Security
EM	0.46	0.01	0.14	0.38
CRITIC	0.27	0.04	0.27	0.42
SD	0.38	0.06	0.21	0.35
MW	0.25	0.25	0.25	0.25

Performance Index of Policy Scenarios



Take away Messages…

- An integrated assessment framework is developed for fiscal incentives promoting electro-mobility in Iceland
- Decision criteria captures government concerns (government revenue and energy security), as well as public interests (consumer expenses and GHG emissions)
- Feebate+Tax scenario has the highest performance index, independent of selected normalization norms and objective weights.

Future Steps

- Expand the sustainability assessment framework to capture the impact of EV charging loads on the transmission network in Iceland
- Engage stakeholders in
  - modifying the MCDA framework (decision criteria, weightings)
  - Evaluating the robustness of development strategies under several possible scenarios

MITSloan MANAGEMENT

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RANNÍS

Thank you for your attention

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