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Switzerland Stakeholder Workshop

**From Deep to Full decarbonisation in the light of Swiss
Energy perspectives 2050+ and Paris Reinforce scenarios**

Marc Vielle (EPFL-LEURE)



www.paris-reinforce.eu

To understand the range of **new technologies** and **behavioral changes** that could contribute to an economy with net-zero greenhouse gas emissions by 2050 at **European level**.

Outline:

- ❖ Presentation of results on **Switzerland** using GEMINI-E3 outputs
- ❖ Presentation of results for the **year 2050** coming from **Paris-Reinforce runs** where deep decarbonization pathways is implemented in EU: -80% reduction / 1990 levels and compare them with results from the **Swiss Energy Perspectives+**
- ❖ Discuss:
 - ❖ Technologies to shift from deep decarbonization to zero emissions (i.e. **game changing innovations**)
 - ❖ Non-technological innovations for significant reduction (**behavioral, societal, etc**)



Figures based on the **1st Swiss Energy Modeling Platform** and the **1 ton of CO₂ per capita** scenario (=85% reduction by 2050 relative to 1990 levels) for **Switzerland**

See: Multi-model comparison of Swiss decarbonization scenarios, F. Landis, A. Marcucci, S. Raush, R. Kannan & L. Bretschger. *Swiss Journal of Economics and Statistics*, 2019.

Landis et al. *Swiss Journal of Economics and Statistics* (2019) 155:12
<https://doi.org/10.1186/s41937-019-0040-8> Swiss Journal of Economics and Statistics

ORIGINAL ARTICLE

Open Access

Multi-model comparison of Swiss decarbonization scenarios



Florian Landis¹, Adriana Marcucci^{1*}, Sebastian Rausch¹, Ramachandran Kannan² and Lucas Bretschger¹

Abstract

Collaborating under the Swiss Energy Modeling Platform (SEMP), five modeling teams (employing an energy systems model and four macroeconomic models with a focus on energy) have carried out a multi-model comparison to assess the economic and technological consequences of reaching emission reduction targets for 2050 in the context of Switzerland. We consider different designs of carbon taxes to compare their economic cost: economy-wide or sector-specific carbon taxes with or without an emission trading system (ETS) in place. All models find that the climate targets can be reached at modest welfare reductions of 0.15–0.37% (if targeting 1.5 tonnes of CO₂ per capita) or 0.24–0.48% (if targeting 1.0 tonnes per capita) compared to a business-as-usual scenario in which the emission level of 1.5 tonnes per capita is exceeded by 83–137%. In contradiction to the additional target of reducing Swiss electricity use, most models find it cost-effective to replace some of the energy supplied by fossil fuels by electricity and thus do not recommend a decrease in electricity use. Most models find that a uniform carbon tax is the most efficient instrument to achieve the emission reduction targets. Those models with a detailed representation of pre-existing mineral oil taxes find that in early periods of climate policy, taxing emission from transport fuels at lower rates than other emissions may be cost-efficient. This effect vanishes as the stringency of targets and thus CO₂ taxes increase over time.

Keywords: Climate policy, Switzerland, Model comparison, Energy system modeling, Computable general equilibrium, Cost-effectiveness

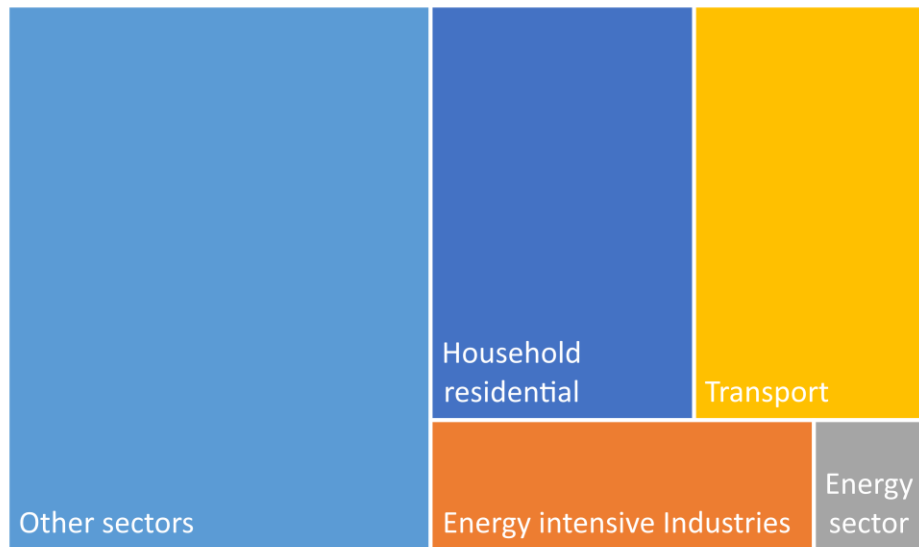
1 Introduction

In concert with other nations under the Paris climate agreement, Switzerland has set itself targets for greenhouse gas (GHG) emission reduction. Even superficial comparisons between current patterns of energy use (with the related emissions) and the required emission reduction requirements for the long run make it clear that a major reduction in energy use and/or restructuring of the energy sector is necessary to meet the targets. Such a transformation will not come without cost, and economists have been looking at how to reach the targets in the optimal way for a while now. Several studies using numerical models have been carried out in order to analyze the technological and economic cost of Swiss climate targets and to compare different policy options for reaching them (see, e.g., Marcucci and Turton (2012);

Scia et al. (2012); Bretschger and Lin (2017); Bretschger et al. (2011); Landis et al. (2018); Böhringer and Müller (2014); Kannan and Turton (2016); Ecoplan (2012); Prognos (2012)).

Comparing the results of the different studies, one inevitably finds differences in results and it remains unclear if these differences between studies arise from analyzing somewhat different problems or if they reflect uncertainty about future economic development or even disagreement about the proper representation of technological options for meeting the targets. Table 1, for example, shows different results for welfare losses according to different studies. The table also lists a selection of key features of the referenced studies such as time horizon, policy target, and reference scenario from which welfare impacts are measured. Clearly, there is a variety of targets and reference scenarios, and the question remains open if the found variation of welfare impacts

The remaining 1 ton of CO₂ per capita in GEMINI-E3



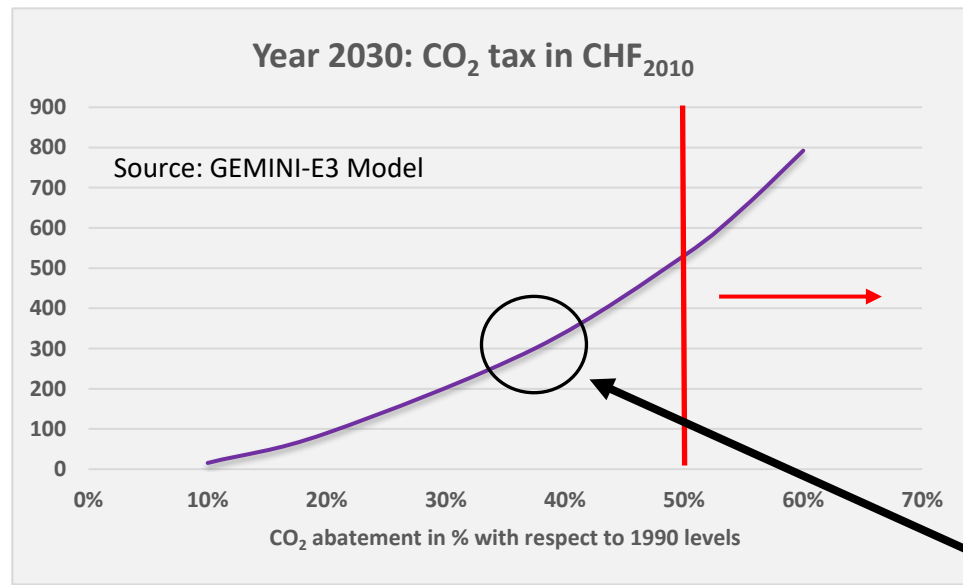
*Correspondence: adriana.marcucci@sempr.ethz.ch
¹Center of Economic Research, ETH Zürich, Zürichbergstrasse 18, 8092, Zürich, Switzerland
 Full list of author information is available at the end of the article



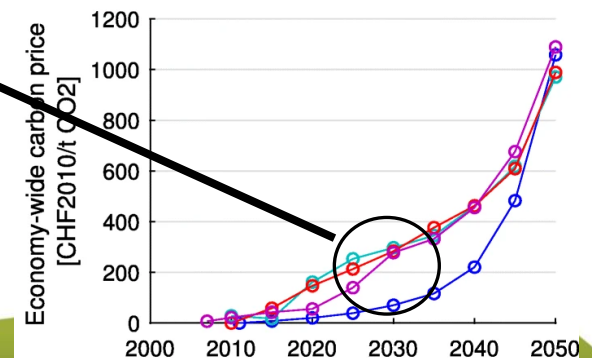
Strengthen the climate ambition in the short term

EU climate ambition from 40% to **55%** in 2030 (ETS: -65%, non-ETS: -40%)

Do we have to increase Swiss climate ambition ? (from 50% to **XX%**)

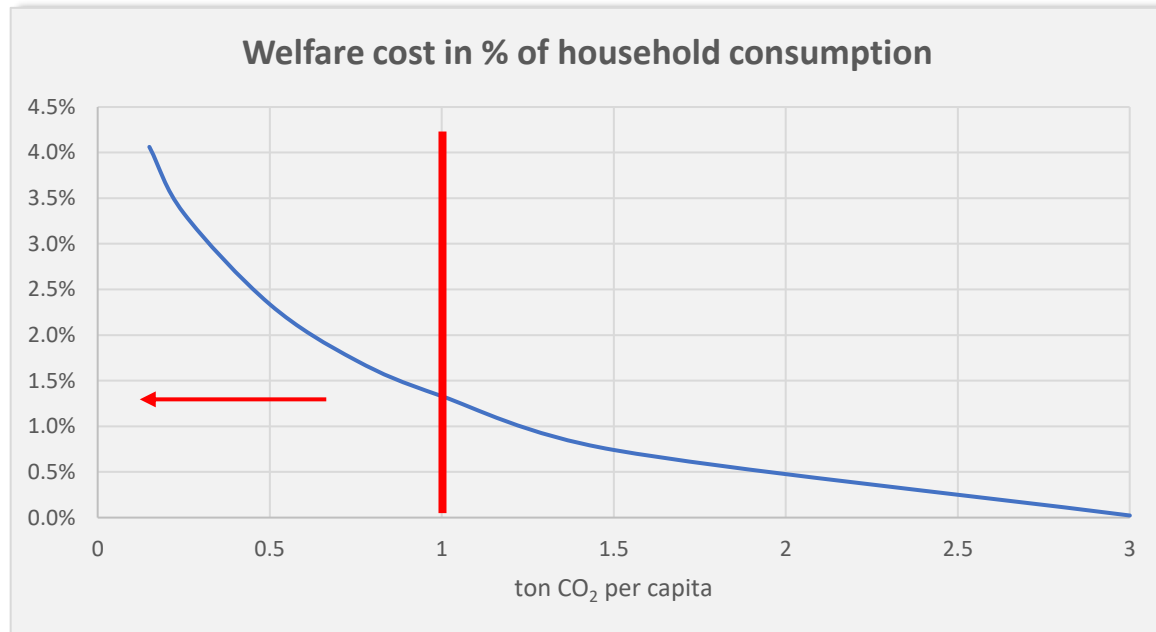


■ CEPE-316 ■ CEPE-HH ■ CITE ■ STEM ■ GEMINI-E3



The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

The remaining 1 ton of CO₂ per capita in 2050



- ❖ **Backstop** technologies
- ❖ Not new in GREEN model (1992): carbon-based backstop fuel, carbon-free backstop fuel, backstop electric option
- ❖ Game changing innovations
 - Power to X
 - CCS
 - BECCS
 - Direct Air Capture
- ❖ IEA, today :Net Zero Roadmap

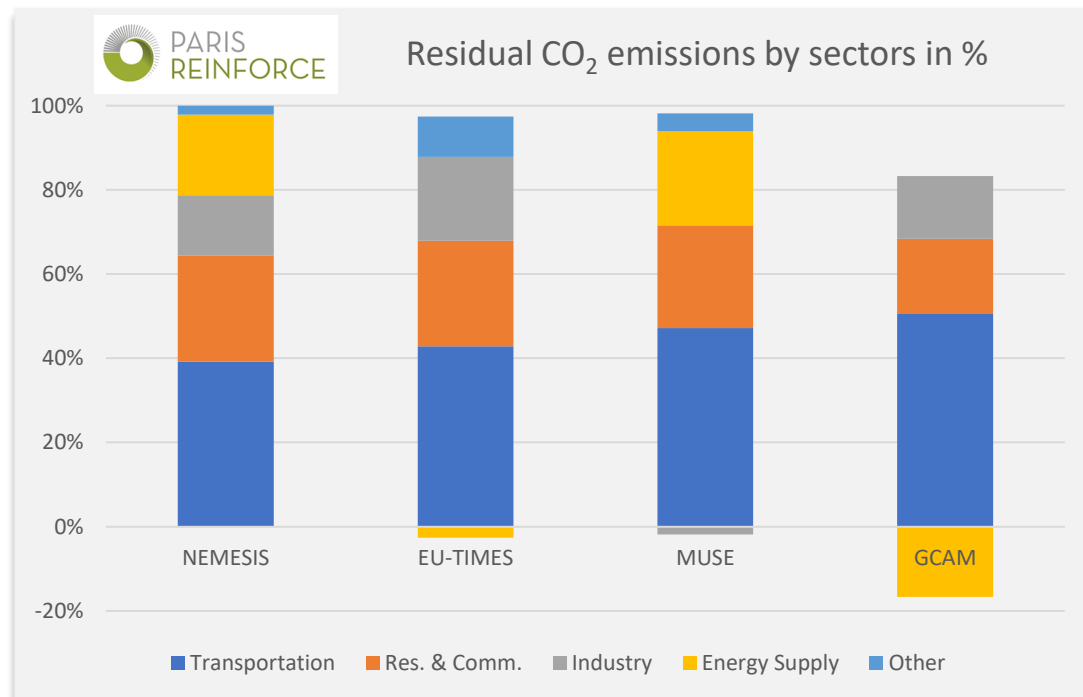
*“in 2050, almost half the reductions come from technologies that are currently only at the **demonstration** or **prototype phase**”*



- ❖ **Changing preferences**
 - ❖ Dietary change
 - ❖ Transport mode switching
 - ❖ Degrowth
- ❖ Do we have to integrate them into our scenarios and how ?
- ❖ Covid-19 and structural effects on energy demand
- ❖ IEA today: *“By 2050, global energy demand is 8% smaller than today”*, behavioral change = 10% by 2050



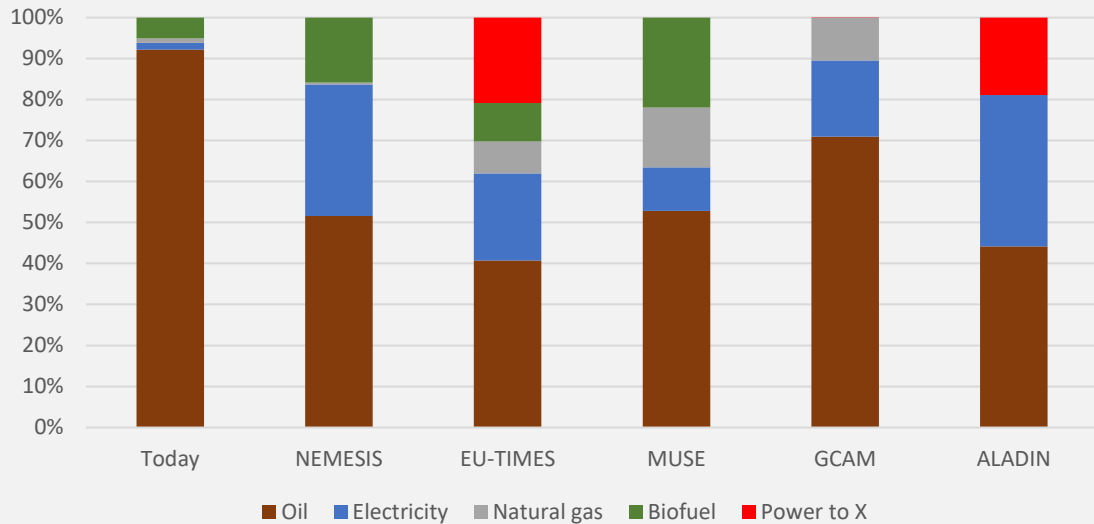
Which parts of the **European emissions** are particularly difficult to eliminate ?



- Two hard spots: Transportation and Buildings
- Industry no common agreement among models
- Energy supply: less challenging with potential negative emissions



European fuel mix in 2050

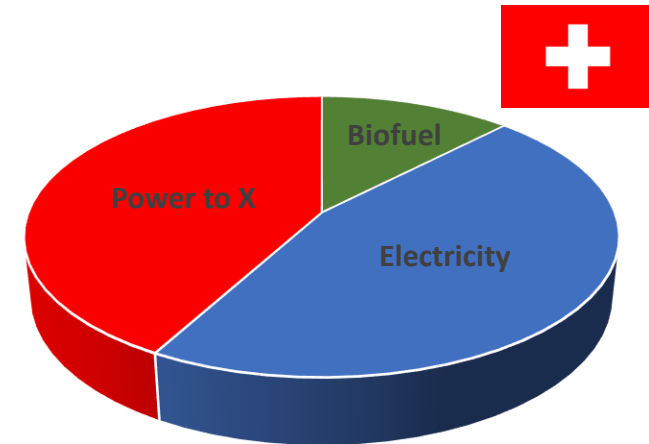


- ❖ Oil remains a key fuel for transportation
- ❖ Strong penetration of e-mobility
- ❖ No agreement on biofuels
- ❖ Alternative fuels in some models: Hydrogen and synthetic fuel

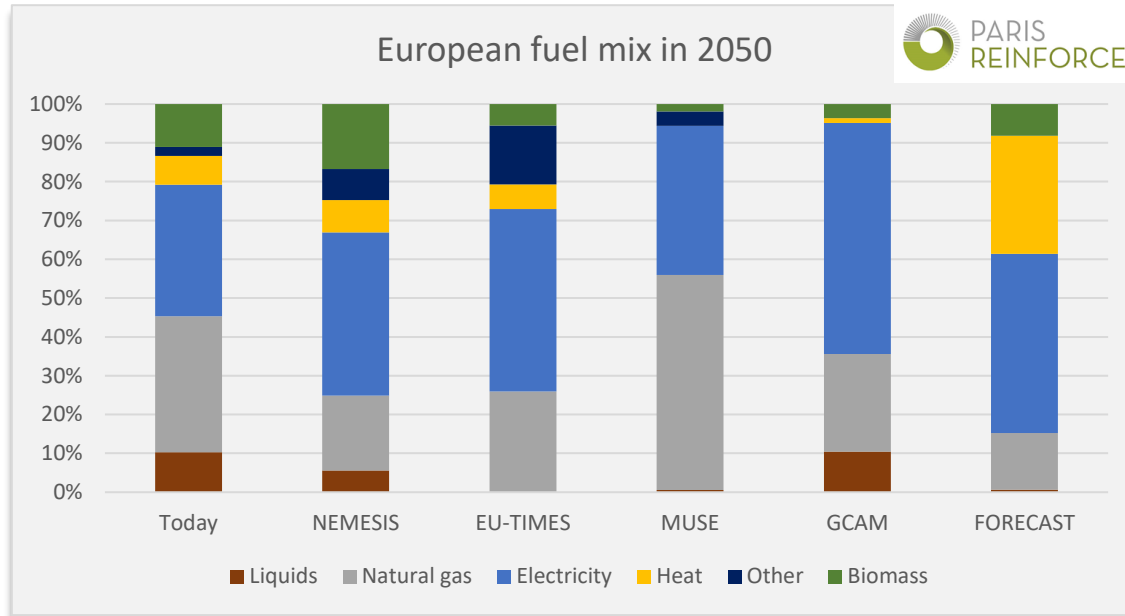
Swiss Energy Perspectives 2050+ (scenario Zero basis)

A balanced mix based on

- E-mobility
- Power to X
- Biofuel



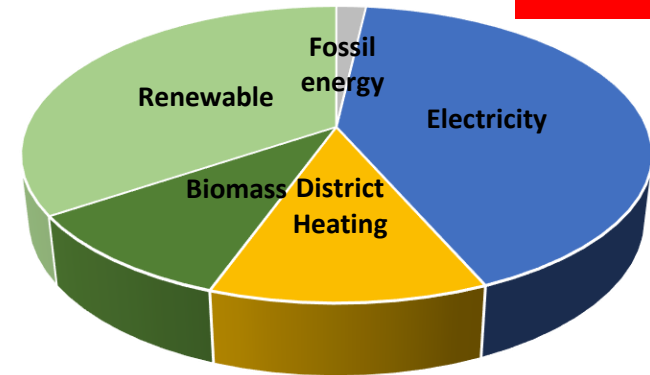
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Swiss Energy Perspectives 2050+

Two main energy carriers

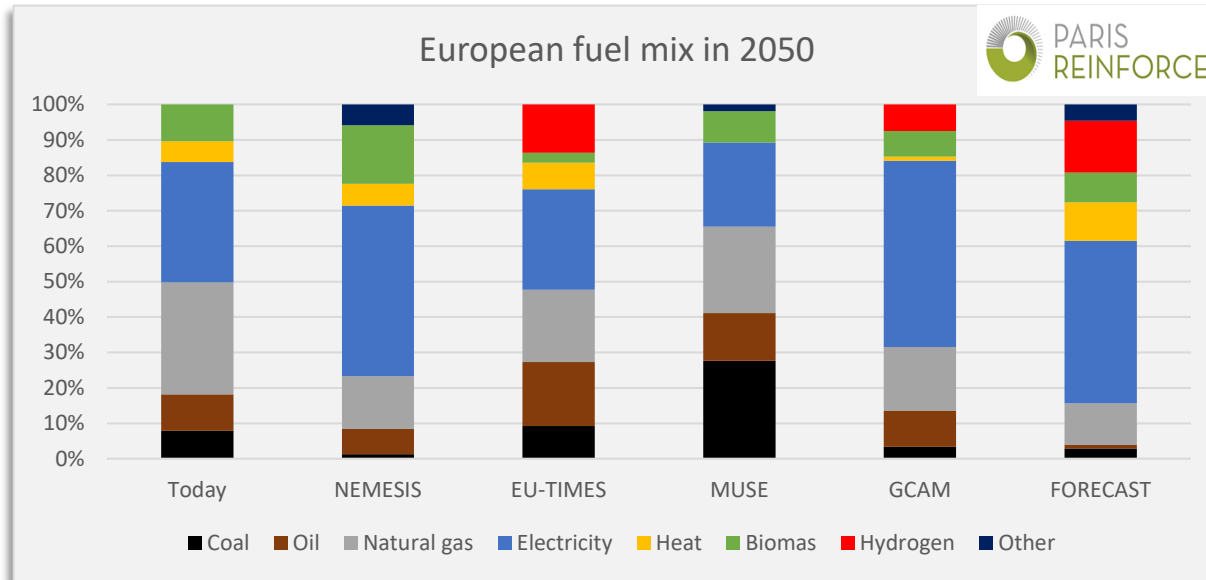
- Renewable
- Electricity



- ❖ Penetration of electricity for heating
- ❖ Gas remain significant

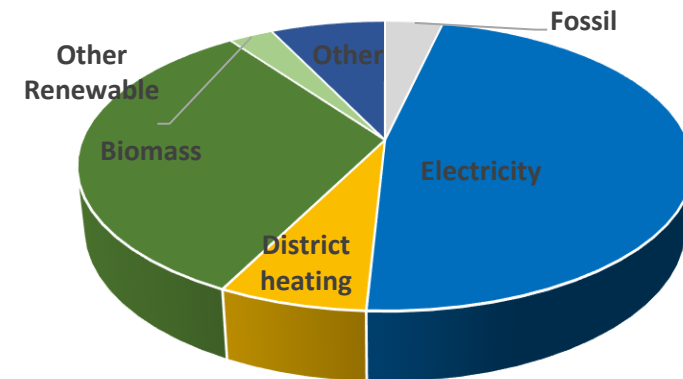


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Swiss Energy Perspectives 2050+

- Electricity
- Renewable



- ❖ A diversified energy mix
- ❖ Where fossil energy remains significant



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TIME FOR QUESTIONS & DISCUSSION



Thank you!

Sigit Perdana: sigit.perdana@epfl.ch

Marc Vielle: marc.vielle@epfl.ch

