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International Reference Centre for the
Life Cycle of Products, Processes and Services

What future for primary aluminium production in a decarbonizing economy?

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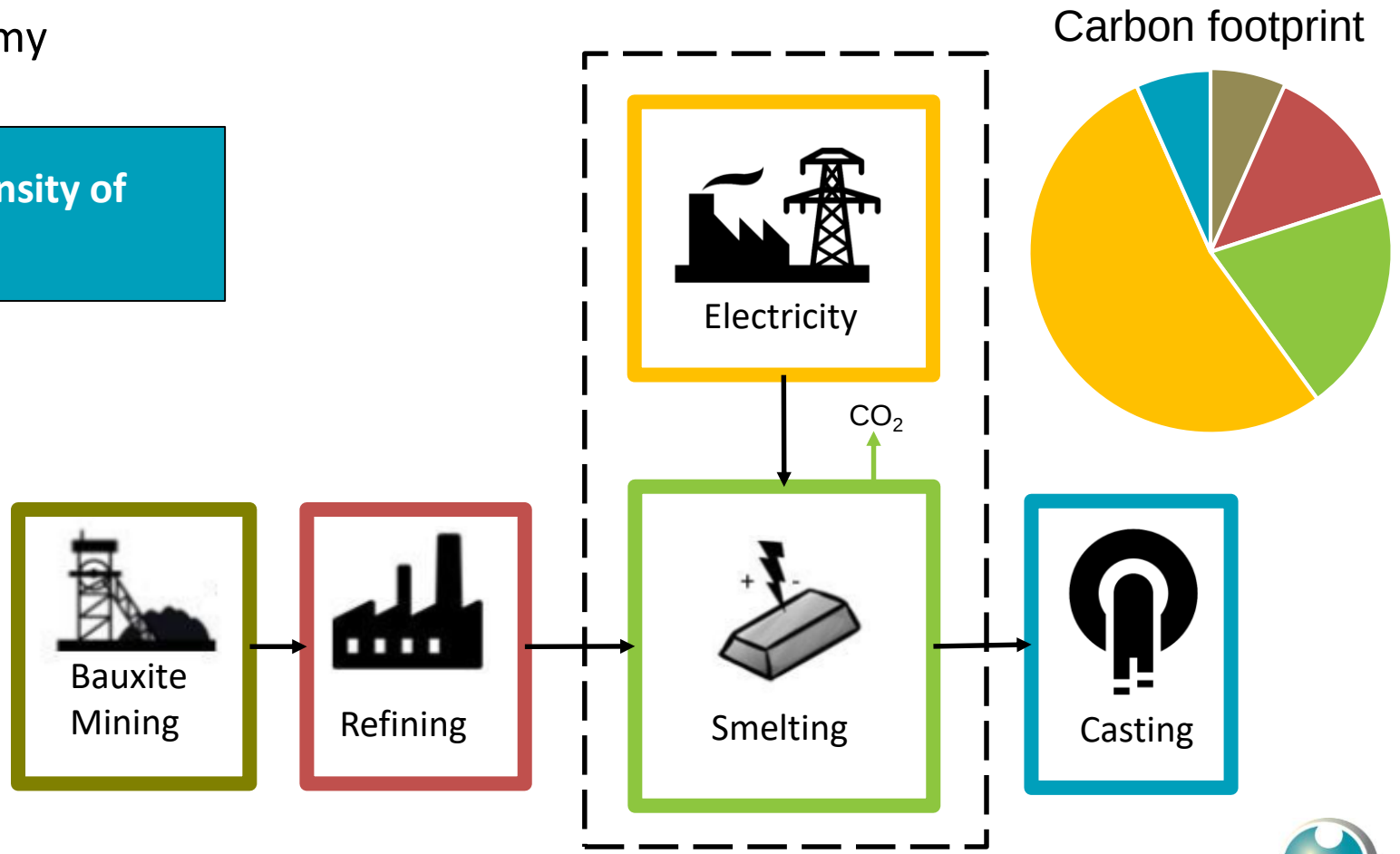
ESG UQÀM

POLYTECHNIQUE MONTRÉAL

The aluminium industry

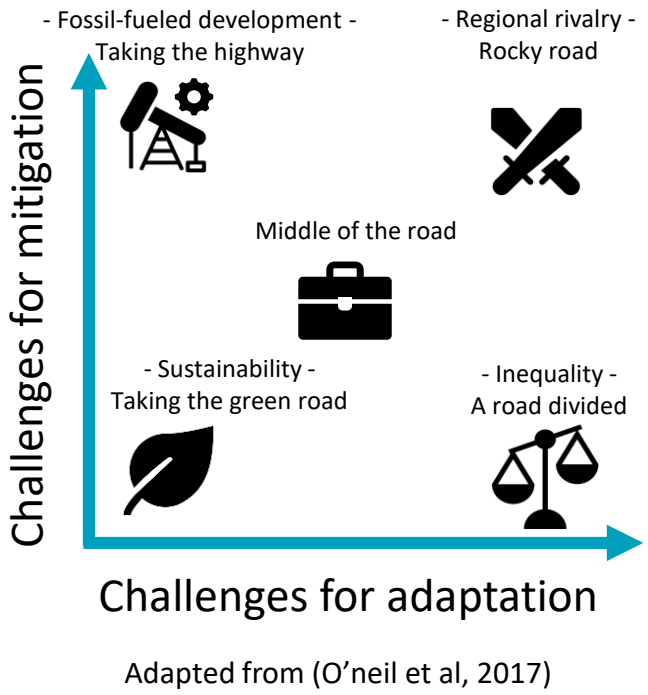
- Second most used metal in our modern economy (63.7 Mt produced in 2019)
- Aluminium could play a major role in the decarbonization of our economy

How to anticipate the carbon intensity of aluminium in the future?



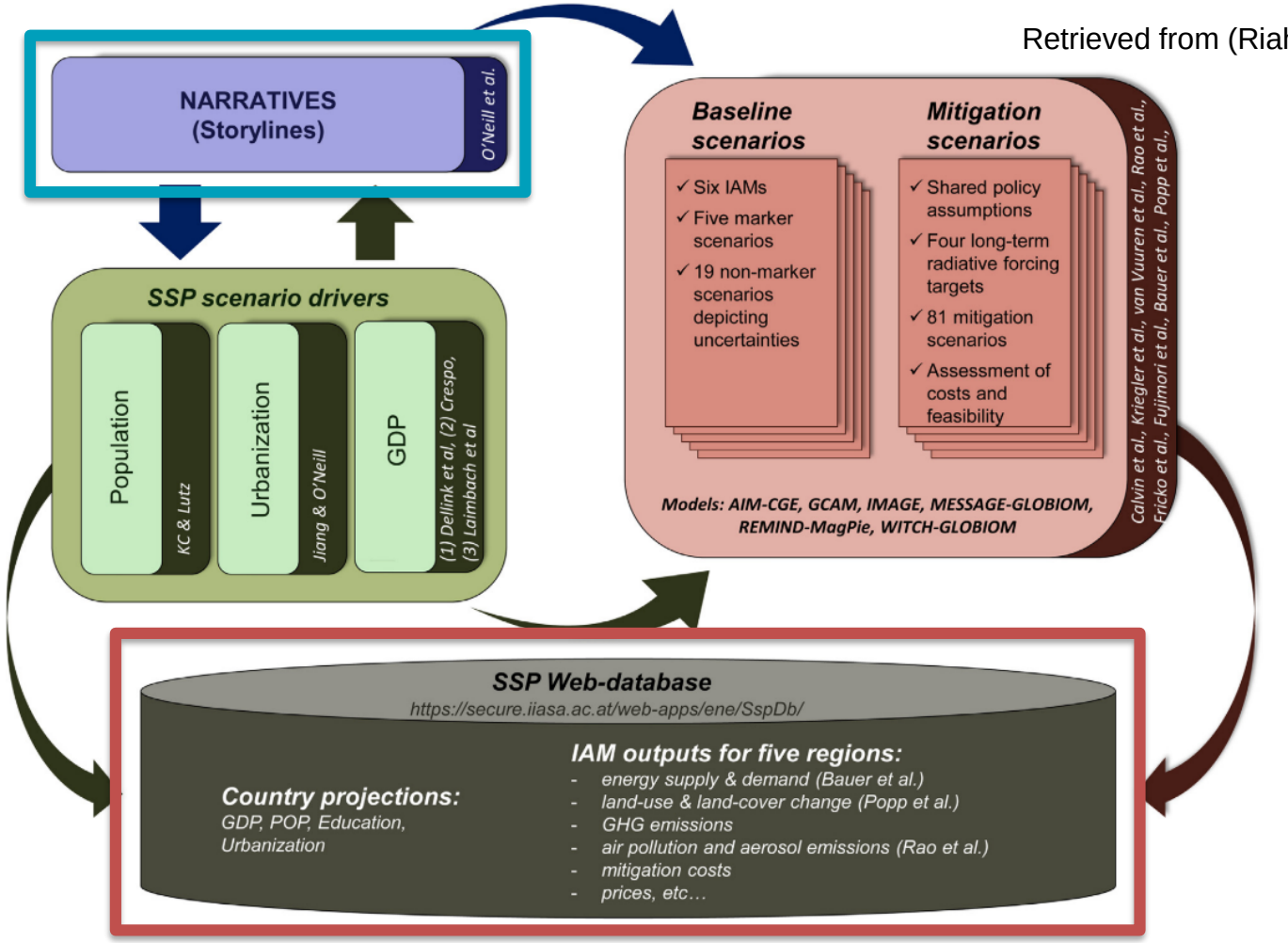
Shared Socioeconomic Pathways (SSP)

Scenario framework used by the climate change research community in order to facilitate the integrated analysis of future climate impacts, vulnerabilities, adaptation, and mitigation (Riahi et al., 2018)

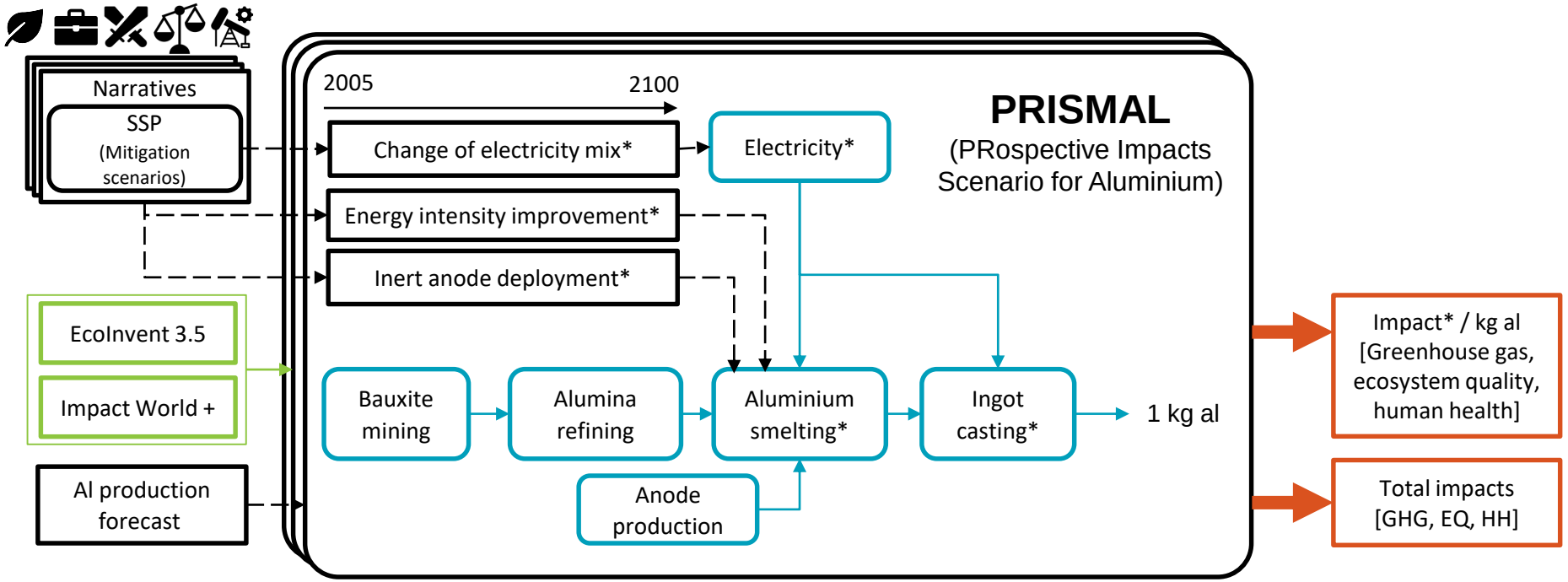


Adapted from (O'neil et al, 2017)

Retrieved from (Riahi et al, 2017)



PRISMAL framework



(Pedneault et al, in preperation)

Scenario	Narratives	Baseline electricity mix	Mitigation scenario mix	Smelting energy intensity	Inert anode deployment
PRISMAL1	“Taking the Green road”	SSP1	1.5 °C / 2.0°C	Low	Quick / Full
PRISMAL2	“Middle of the road”	SSP2	1.5 °C / 2.0°C	Medium	Normal / Partial
PRISMAL3	“A rocky road”	SSP3		High	Not at all
PRISMAL4	“A road divided”	SSP4	2.0 °C	Medium*	Normal / Partial
PRISMAL5	“Taking the highway”	SSP5	1.5 °C / 2.0°C	Medium	Quick (late) / Full

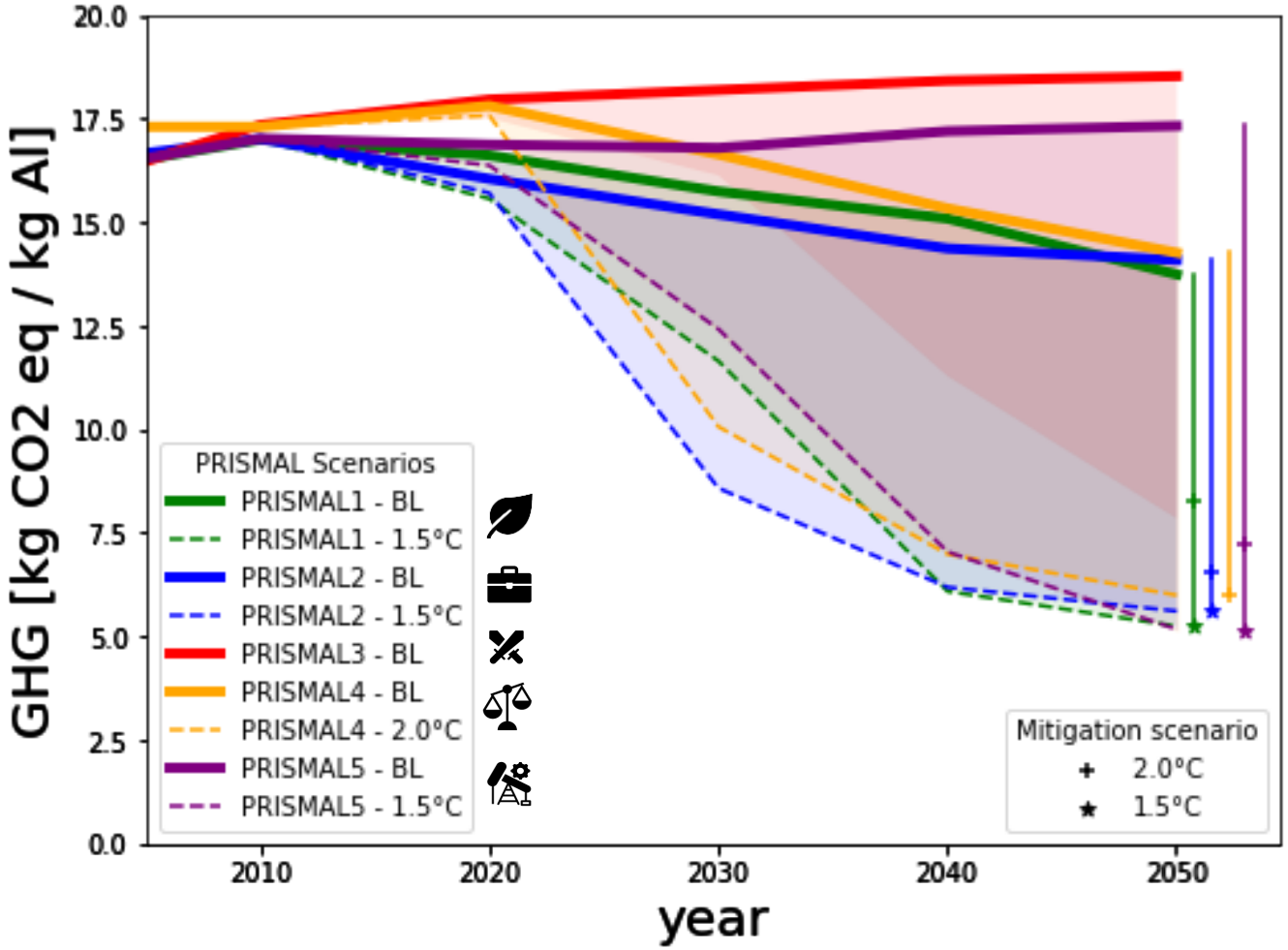
PRISMAL results – Carbon intensity

Baseline scenario – 2050

- 17 and 13.7 kg CO2 eq/kg Al
- No improvement for narrative 3-5

Mitigation scenario – 2050

- 5.2 kg CO2 eq/kg Al



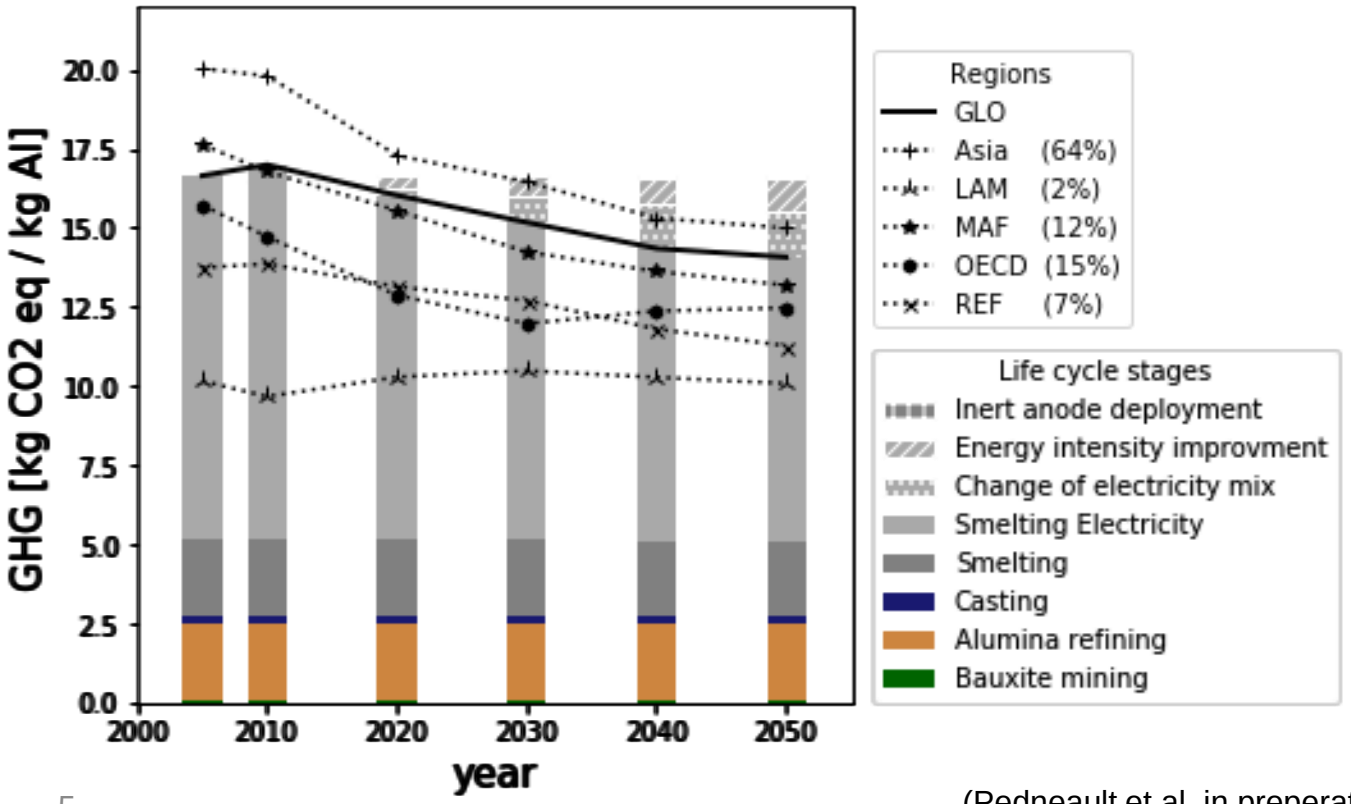
(Pedneault et al, in preperation)

PRISMAL results – Contribution analysis - PRISMAL2

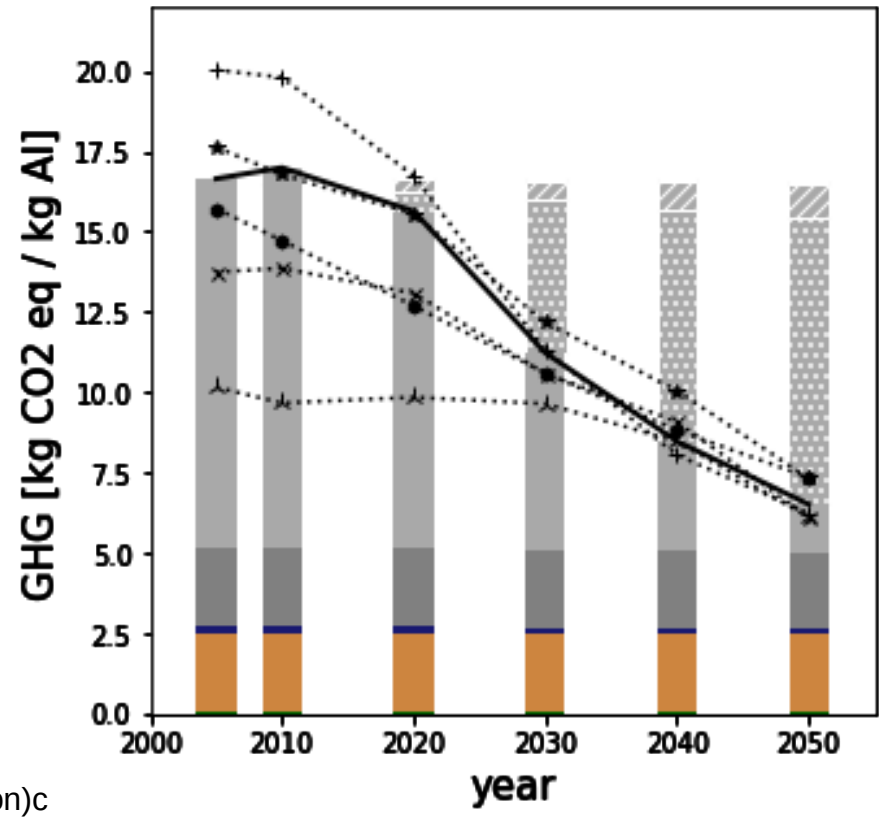
Contribution analysis
- High potential of improvement from electricity mix

Region convergence

Baseline



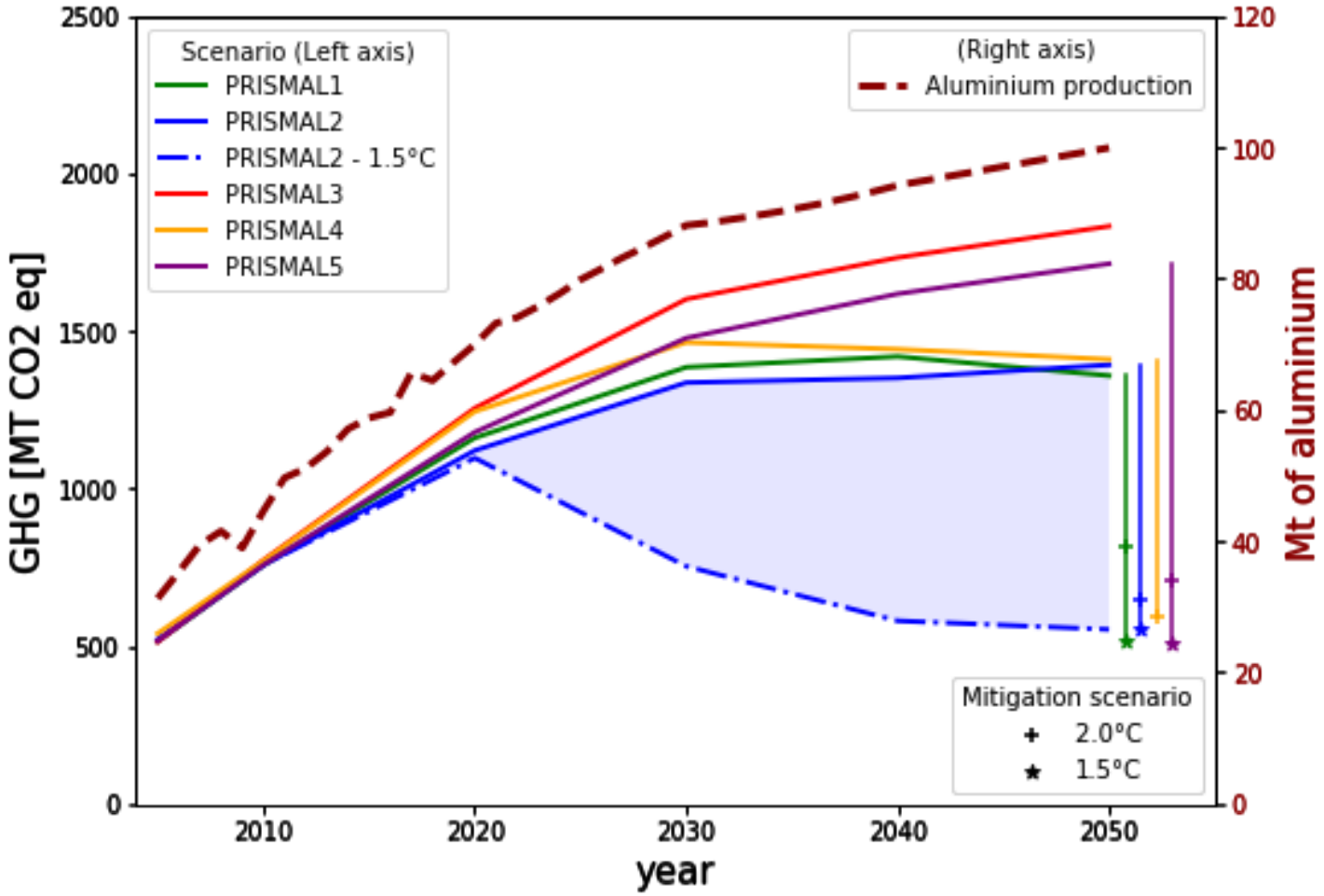
2.0°C mitigation



(Pedneault et al, in preperation)c

PRISMAL results – Scaling of emissions

Future production from IAI data and dynamic MFA*



(Pedneault et al, in preperation)

*Bertram, M. *et al.* A regionally-linked, dynamic material flow modelling tool for rolled, extruded and cast aluminium products. *Resour. Conserv. Recycl.* **125**, 48–69 (2017).

Learnings

For the aluminium sector

- Major improvement can realistically be achieved before 2050
  - **Energy policy**
  - **Energy intensity of the Hall-Heroult process**

For the LCA community

- SSPs framework, narratives and results are a good anchorage for scenario modelling in LCA
  - **Ensure consistency within scenarios**
  - **Ease the link with broader scientific community**

DEDICATED PARTNERS

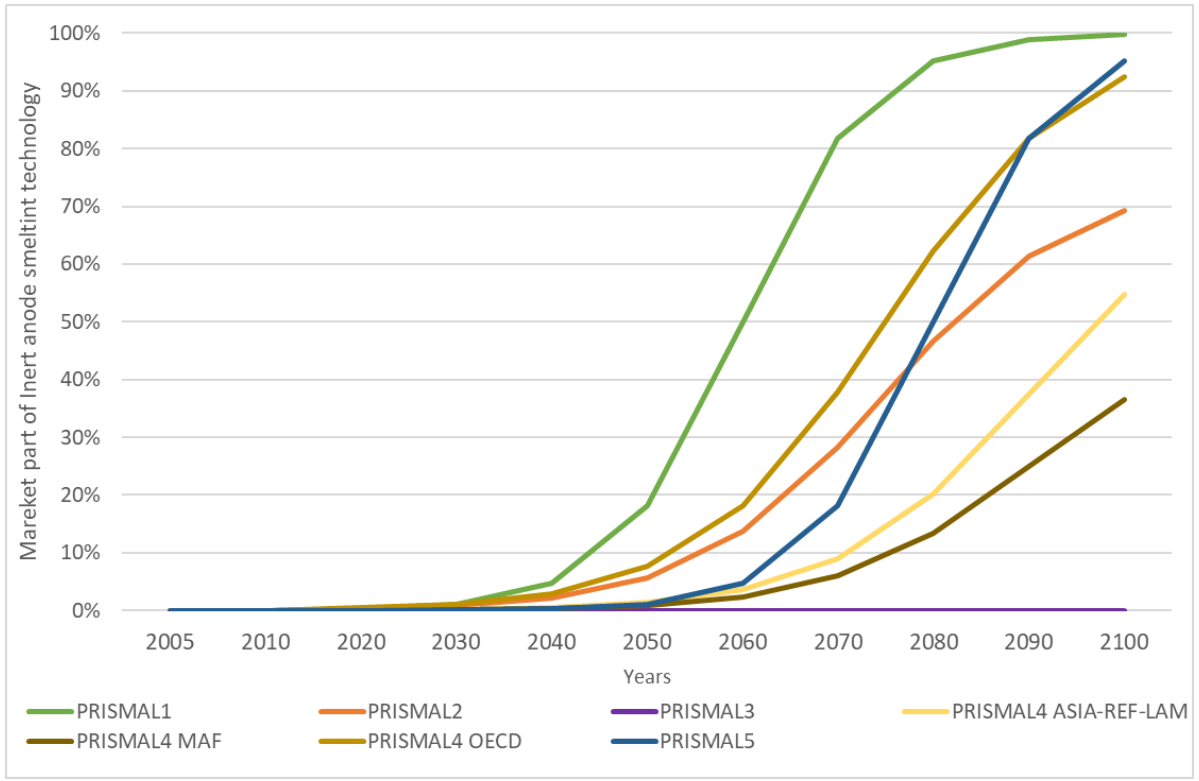
Questions?

Appendix

PRISMAL evolution of key parameters

Inert anode penetration rate

$$D_{in,t} = \frac{A}{1 + e^{-k * (t - t_h)}}$$



Smelting energy intensity

$$\rho = \frac{a}{(t-h)} + \frac{b}{(t-h)^2} + 6.23$$