# $CO_2$ emission reductions in Switzerland and developing countries

## Drawing from SR15 and our research

**Philippe Thalmann**

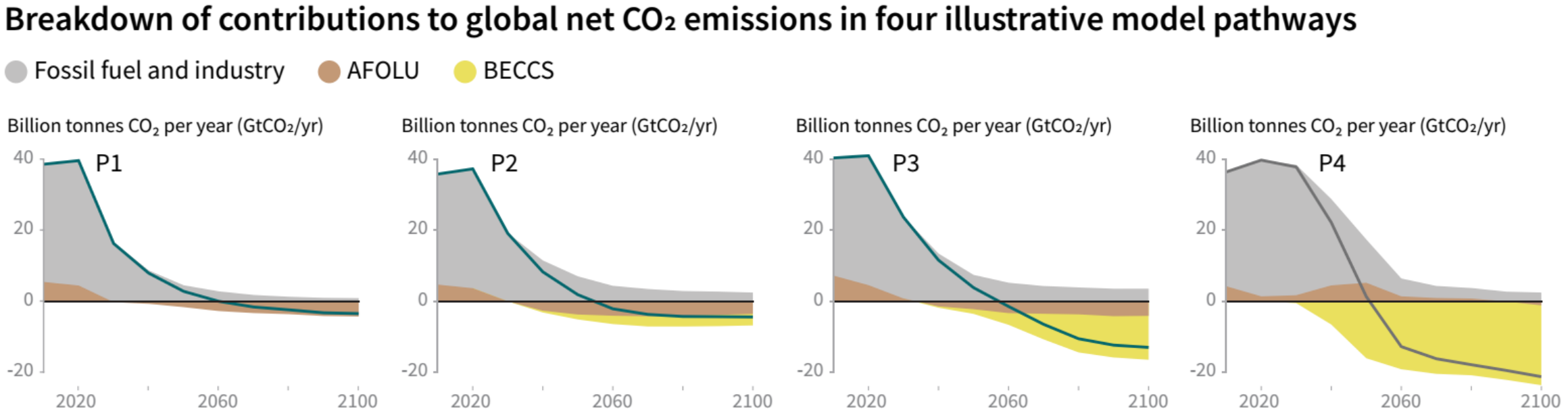
Professor of environmental economics EPFL

Member of OcCC

Séminaire/BBL Changement climatique et croissance économique, Berne, 19 mars 2019

# WHAT THE IPCC SR 1.5° REPORT IMPLIES IN TERMS OF EMISSIONS REDUCTIONS AND POSSIBLE COSTS

# Pathways compatible with global budget




**P1:** A scenario in which social, business and technological innovations result in lower energy demand up to 2050 while living standards rise, especially in the global South. A downsized energy system enables rapid decarbonization of energy supply. Afforestation is the only CDR option considered; neither fossil fuels with CCS nor BECCS are used.

**P2:** A scenario with a broad focus on sustainability including energy intensity, human development, economic convergence and international cooperation, as well as shifts towards sustainable and healthy consumption patterns, low-carbon technology innovation, and well-managed land systems with limited societal acceptability for BECCS.

**P3:** A middle-of-the-road scenario in which societal as well as technological development follows historical patterns. Emissions reductions are mainly achieved by changing the way in which energy and products are produced, and to a lesser degree by reductions in demand.

**P4:** A resource- and energy-intensive scenario in which economic growth and globalization lead to widespread adoption of greenhouse-gas-intensive lifestyles, including high demand for transportation fuels and livestock products. Emissions reductions are mainly achieved through technological means, making strong use of CDR through the deployment of BECCS.

SR15, SPM fig. 3b



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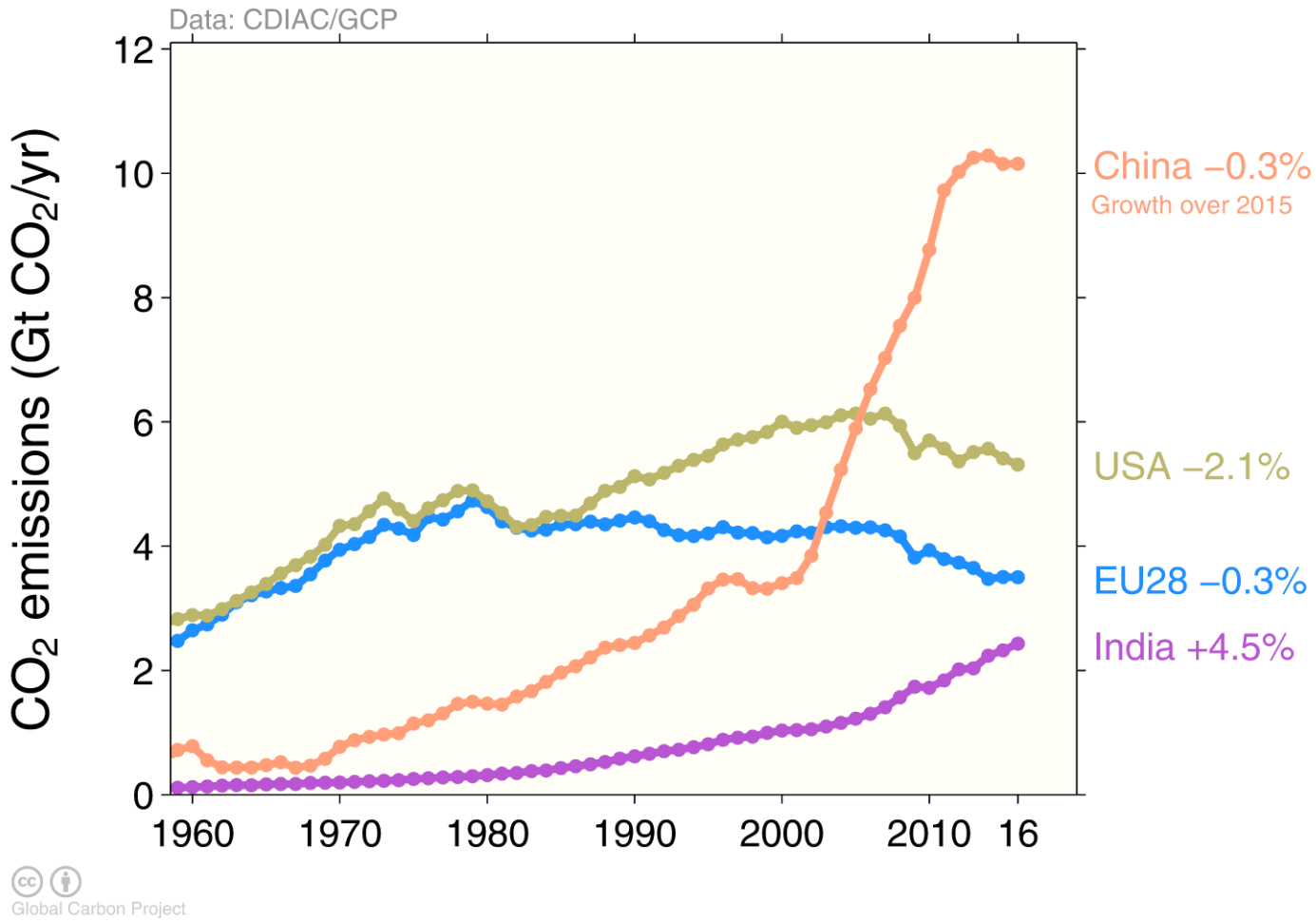
# All pathways require rapid and profound transformations

- Net $CO_2$ emissions = 0 around 2050
- Transformation of energy use: deep electrification and energy efficiency improvements in buildings, mobility, industry
- Transformation of electricity generation: mostly renewables (70-85% in 2050), no more coal
- Profound changes in land use, depending on scenario
- **Nothing unheard of, even a speed of transformation that is known, but the scale is new**

# Emissions are declining in some regions




Global Carbon Project. (2017). Supplemental data of Global Carbon Budget 2017 (Version 1.0) [Data set]. Global Carbon Project. https://doi.org/10.18160/gcp-2017



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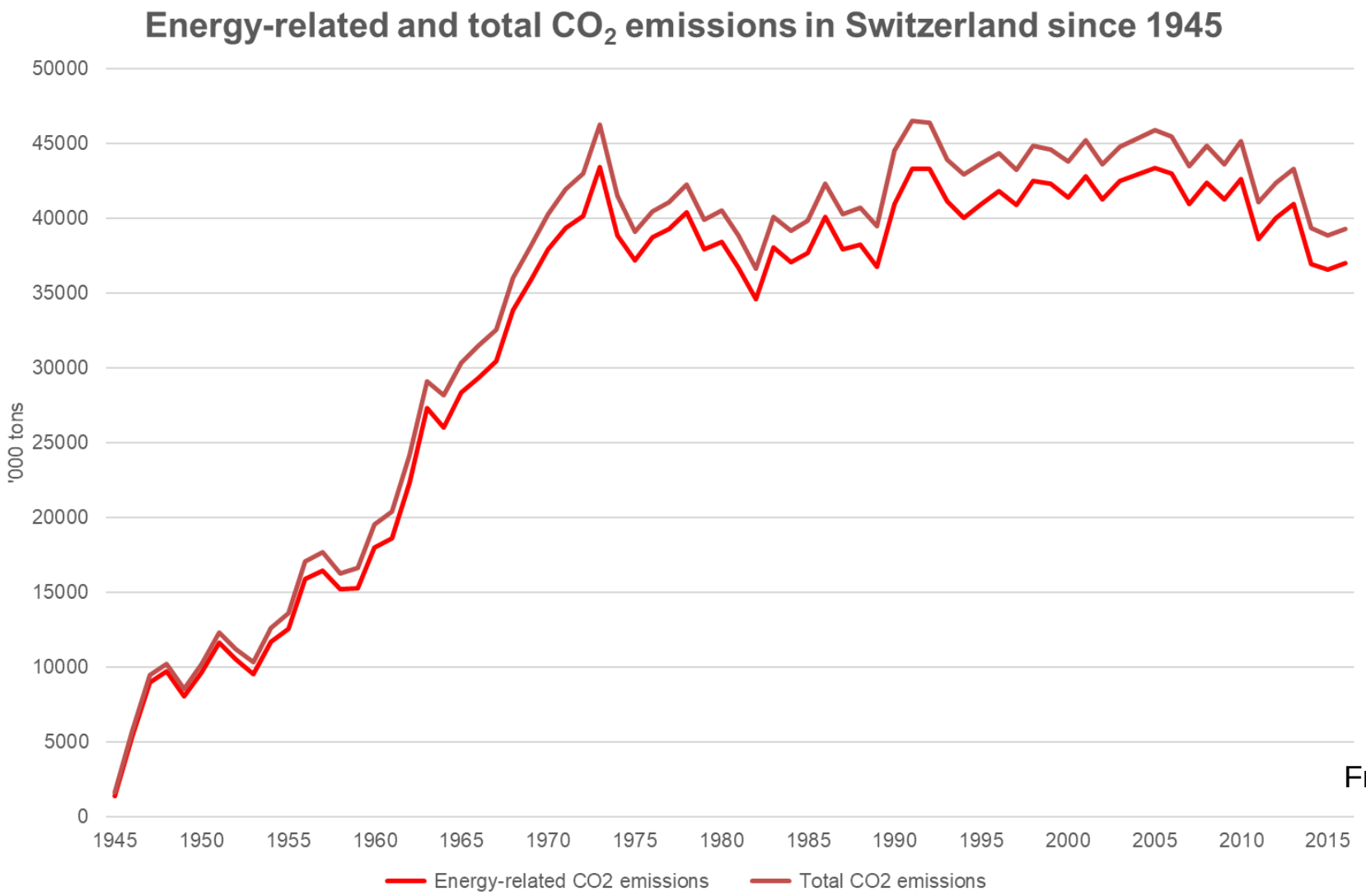
# Emissions are declining in Switzerland but very slowly




From Fed. off. env. data



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# What would it cost?

- No estimates of total costs in SR15, only marginal costs
- These are very high, 3-4× higher than for +2°
- Marginal costs do not mean much when the cost curve gets very steep
- Many measures are costless or generate greater external benefits than private costs (clean air, clean water, clean soils)

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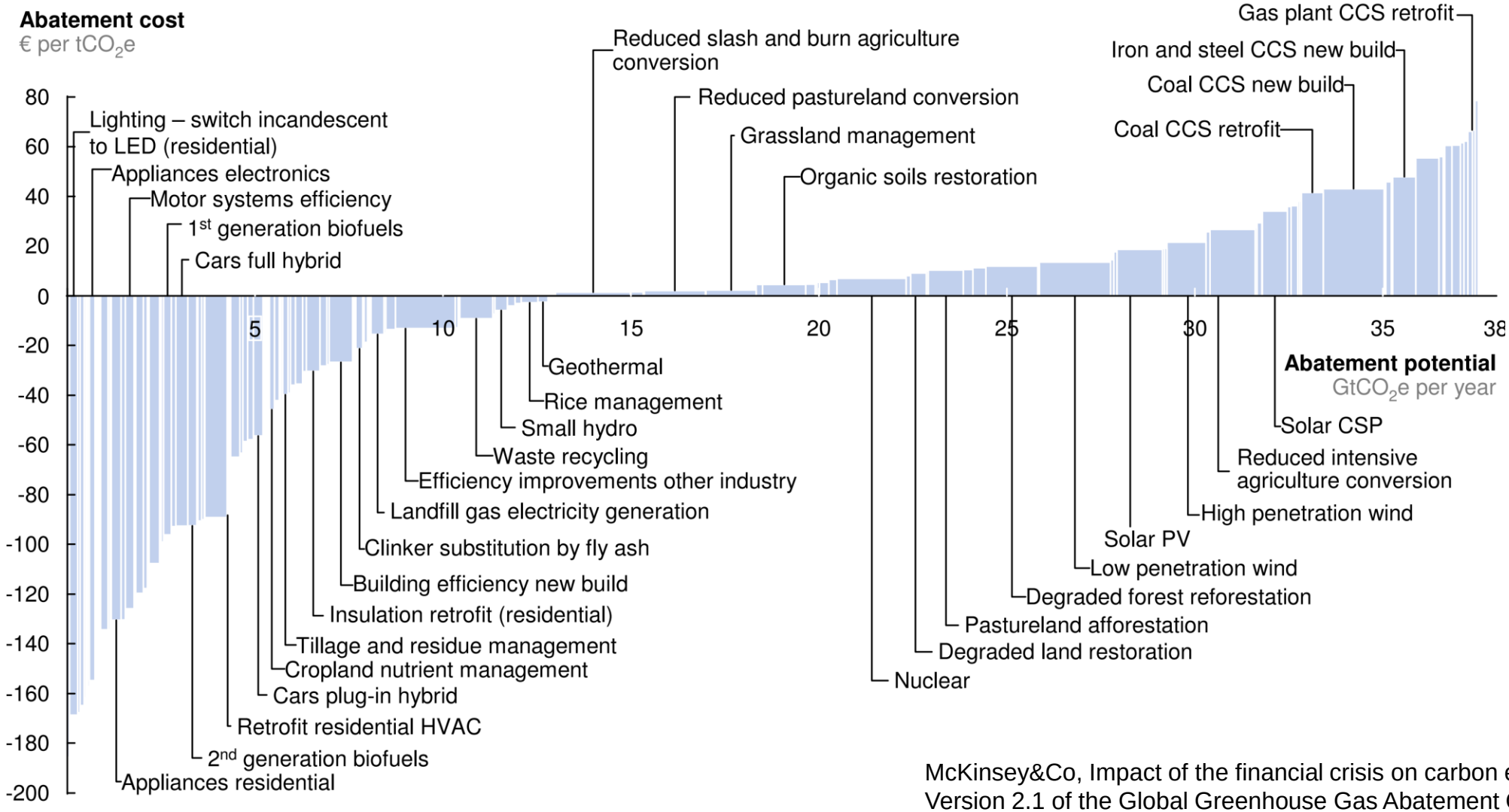
# What would it cost?




McKinsey&Co, Impact of the financial crisis on carbon economics. Version 2.1 of the Global Greenhouse Gas Abatement Cost Curve, 2010

Note: The curve presents an estimate of the maximum potential of all technical GHG abatement measures below €80 per $tCO_2e$ if each lever was pursued aggressively. It is not a forecast of what role different abatement measures and technologies will play.
Source: Global GHG Abatement Cost Curve v2.1



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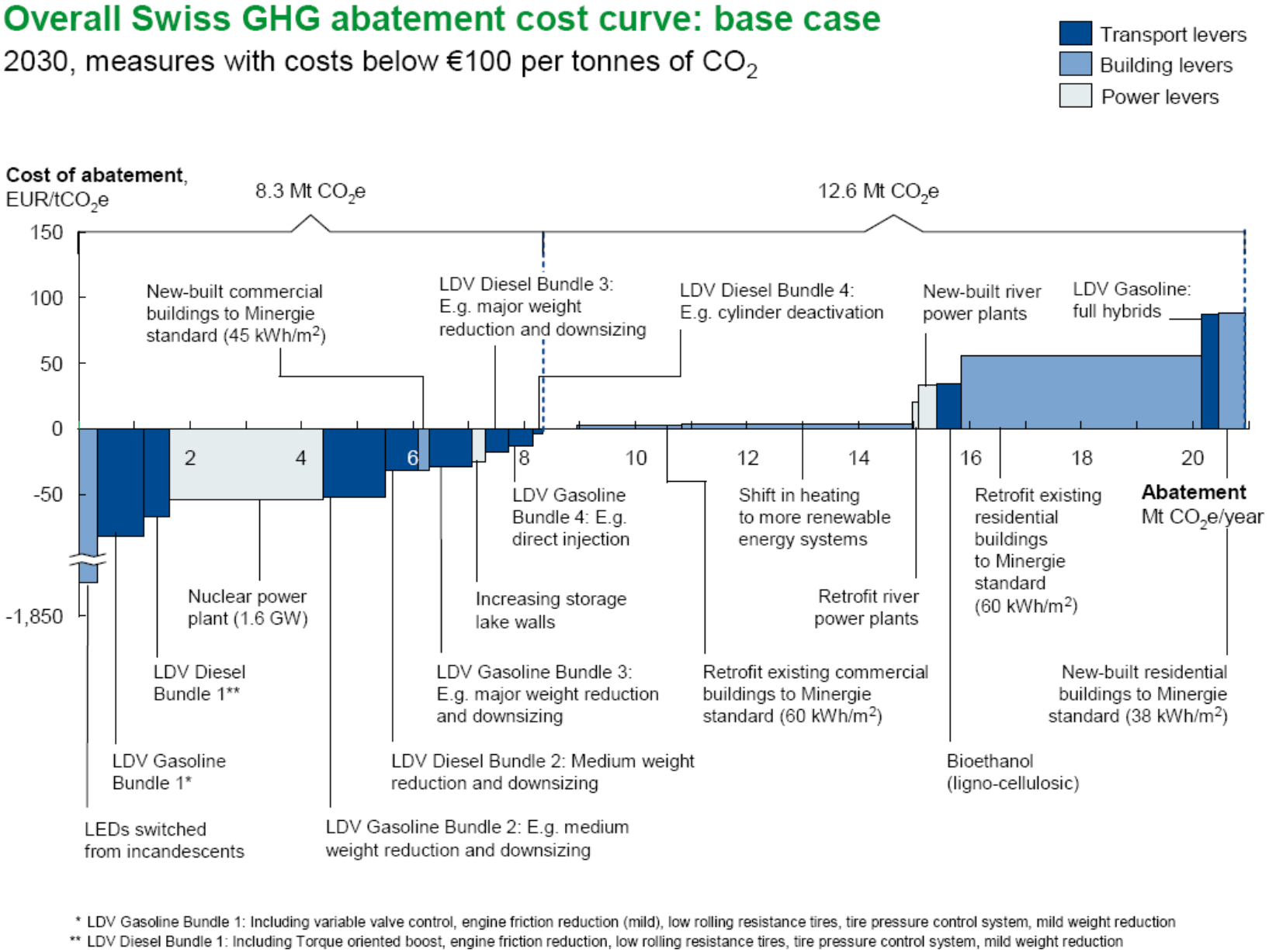
# What would it cost in Switzerland?




McKinsey, Swiss Greenhouse Gas Abatement Cost Curve, 2009

* LDV Gasoline Bundle 1: Including variable valve control, engine friction reduction (mild), low rolling resistance tires, tire pressure control system, mild weight reduction

** LDV Diesel Bundle 1: Including Torque oriented boost, engine friction reduction, low rolling resistance tires, tire pressure control system, mild weight reduction

# Incomes of 4 billion CHF are at stake in the Swiss oil industry alone

| | Billion CHF, 2017 |
|---|---|
| Spending for final energy use | 26.5 |
| ./. Electricity | - 10.0 |
| Spending for final use of fossil energy | 16.5 |
| ./. Petroleum tax | - 4.6 |
| ./. $CO_2$ tax | - 1.1 |
| ./. Value-added tax | - 1.2* |
| Spending for final use of fossil energy without taxes | 9.6 |
| ./. Imports of fossil energy | - 5.7 |
| Net domestic incomes from sale of fossil energy | 3.9* |

Data sources: Fed. off. of energy (Gesamtenergiestatistik), Fed. finance admin. and Federal customs admin. / * = Estimates

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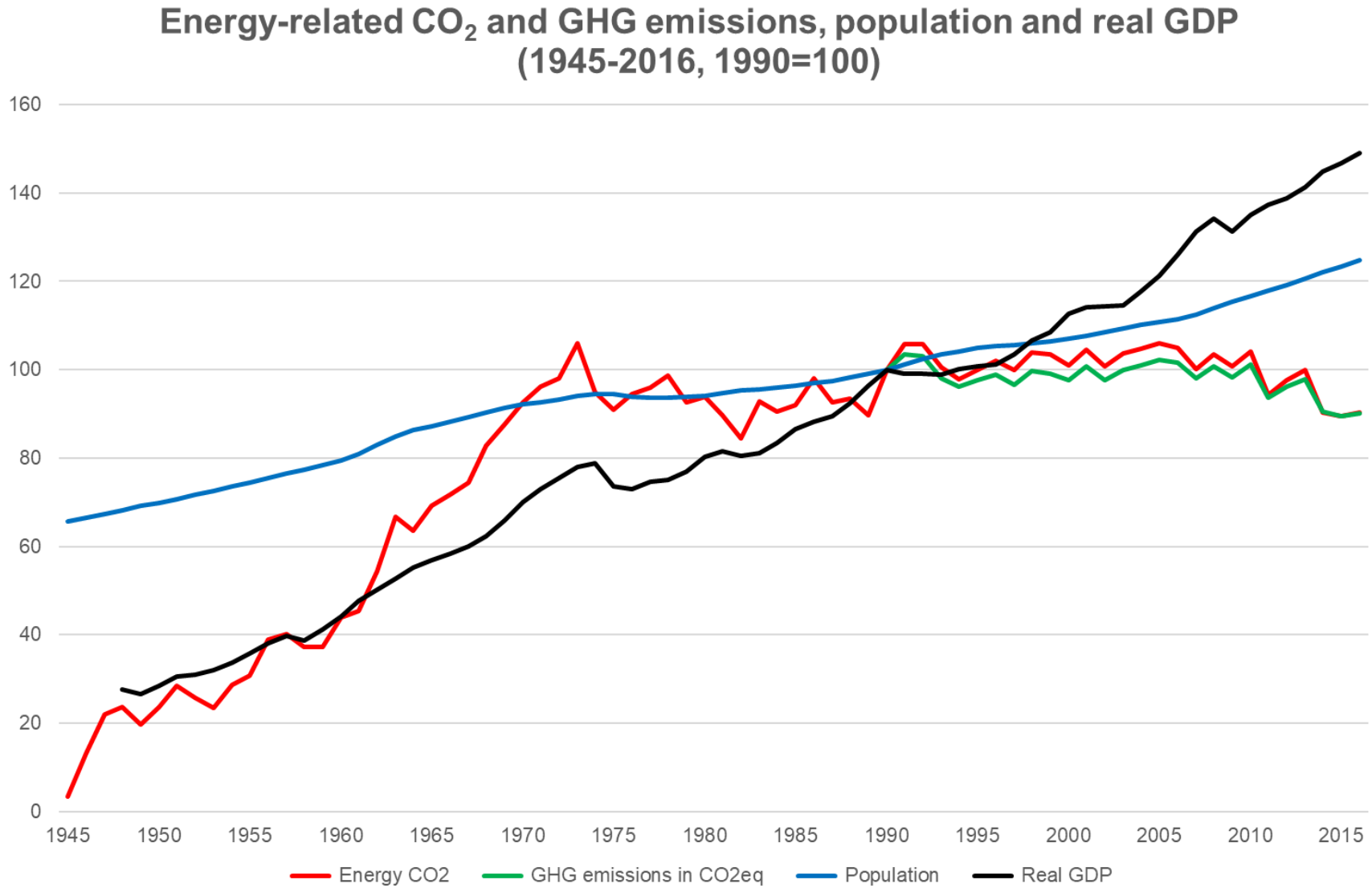
# ACHIEVEMENTS AND CHALLENGES IN SWITZERLAND

# What was achieved in Switzerland?

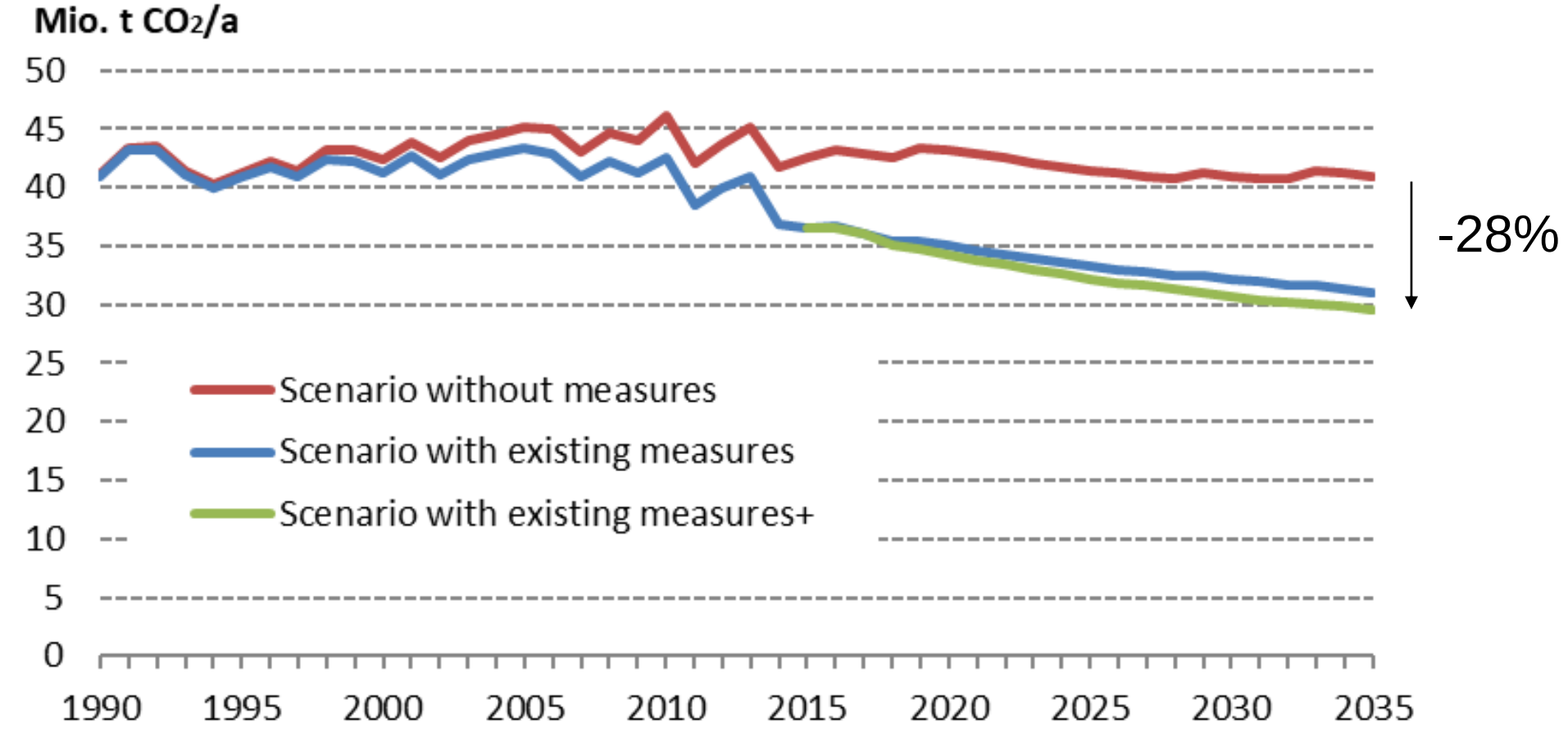
Decoupling after first oil-price shock (1973)
Many causes, among which the shift from domestic production to imports of industrial goods




From Fed. off. env. and Fed. off. of statistics data

# How much is attributable to policy?

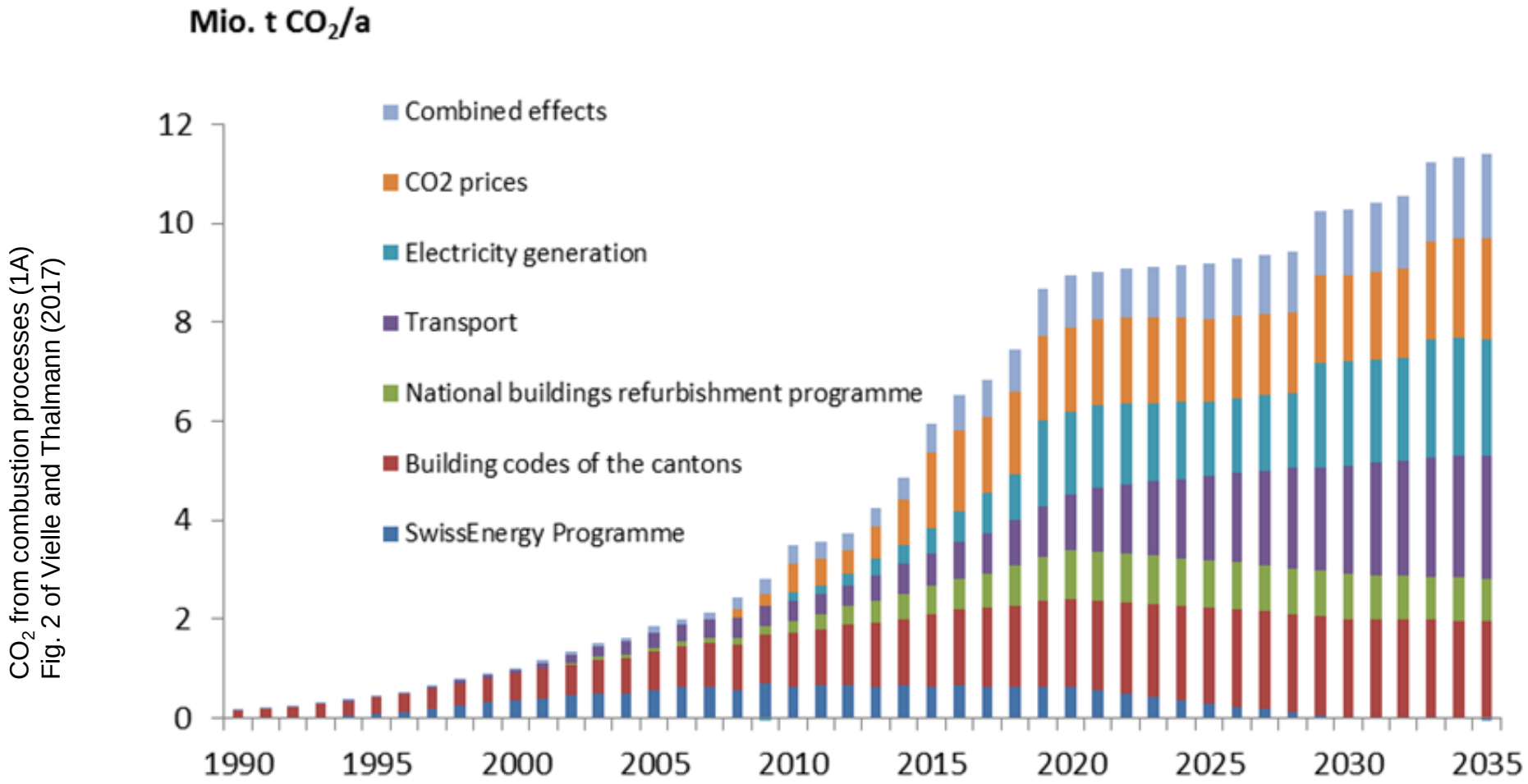
Energy-related $CO_2$ emissions in a scenario without measures and two scenarios with existing and announced measures (1990-2035)




$CO_2$ from combustion processes (1A)
Fig. 1 of Vielle and Thalmann (2017)

# Effectivity of differents components of "climate policy"

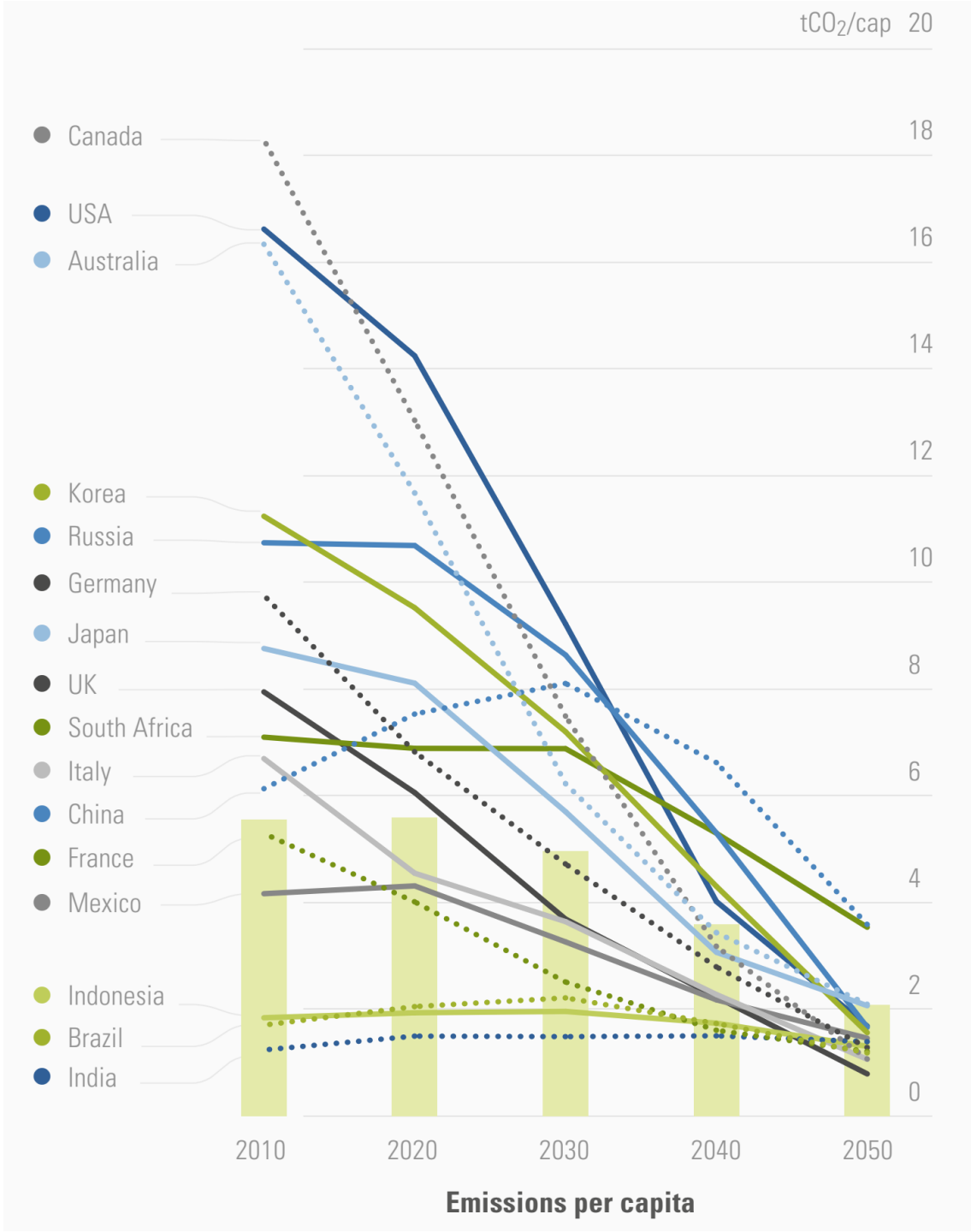
Total reduction of $CO_2$ emission in scenario with decided measures compared to scenario without measures, by group of measures (1990-2035)




$CO_2$ from combustion processes (1A)
Fig. 2 of Vielle and Thalmann (2017)

# Decarbonisation pathways for Switzerland

In parallel with *Deep Decarbonization Pathways Project* (DDPP) launched in October 2013 in view of COP21 (Paris)




Deep Decarbonization Pathways Project (2015), Pathways to deep decarbonization 2015 report - executive summary, SDSN – IDDRI, Fig. 2



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# Decarbonisation pathways for Switzerland

- Ambitious but realistic target: **1-1.5 $tCO_2eq$/capita** in 2050 (all GHGs without air transport and without LULUCF)
- Same target as the "NEP" scenario of the Energy Perspectives (Prognos, 2012) and as the Swiss INDC for COP21
- This target was seen as compatible with **+2° warming**
- Imagine and calculate the instruments necessary to achieve this: use existing instruments plus generalised $CO_2$ tax

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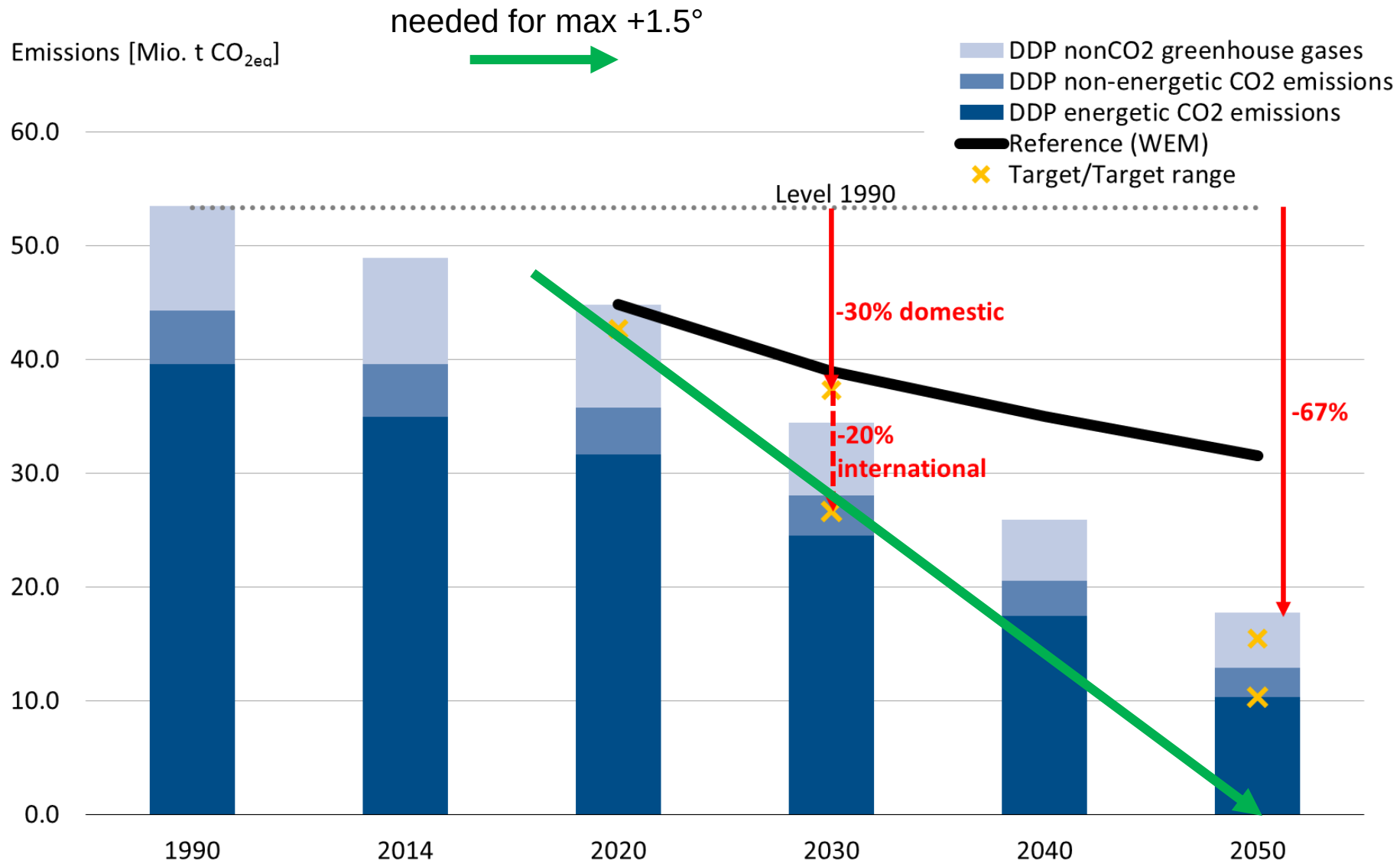
# Deep decarbonisation pathways (for max +2°)




Schäppi et al. (2016)



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# How to get to 1t $CO_2$/capita in 2050

| | 2020 | 2030 | 2040 | 2050 |
|---|---|---|---|---|
| $CO_2$ tax ($CHF_{2013}/tCO_2$) | 177 | | | |
| Price of $CO_2$ certificats ($CHF_{2013}/tCO_2$) | 82 | | | |
| Tax on gasoline and diesel ($CHF_{2013}/l$) | 0.05 | | | |
| Same $CO_2$ tax on all fossils ($CHF_{2013}/tCO_2$) | | 88 | 189 | 511 |
| Social cost (% household consumption, relative to reference scenario) | | 0.11 | 0.42 | 0.78 |

Vielle et al. (2016). Scenario with induced technical progress (CCS is allowed)

511 CHF/$tCO_2$ with emissions of 1 $tCO_2$/capita on average in 2050 is comparable to 128 CHF/$tCO_2$ for current emissions of 4 $tCO_2$/capita

511 CHF/$tCO_2$ amount to 1.35 CHF/litre heating oil, which are added to the expected pre-$CO_2$ -tax price of 1.40 CHF/litre in 2050

# Contributions of consumption and technology in the case of house heating

**Mean annual rate of change per decade**

Decarbonisation scenario with induced technical change

| | 2010-2020 | 2020-2030 | 2030-2040 | 2040-2050 |
|---|---|---|---|---|
| *Population* | *+1.6%* | *+0.4%* | *+0.3%* | *+0.2%* |
| *GDP per capita* | *-0.1%* | *+1.0%* | *+0.9%* | *+0.7%* |
| Heated surface | +1.5% | +1.1% | +0.7% | +0.6% |
| Energy intensity | -3.7% | -2.7% | -3.3% | -3.5% |
| Carbon intensity | -0.0% | -0.6% | -1.3% | -3.7% |
| **$CO_2$ emissions** | **-2.3%** | **-2.2%** | **-3.9%** | **-6.5%** |

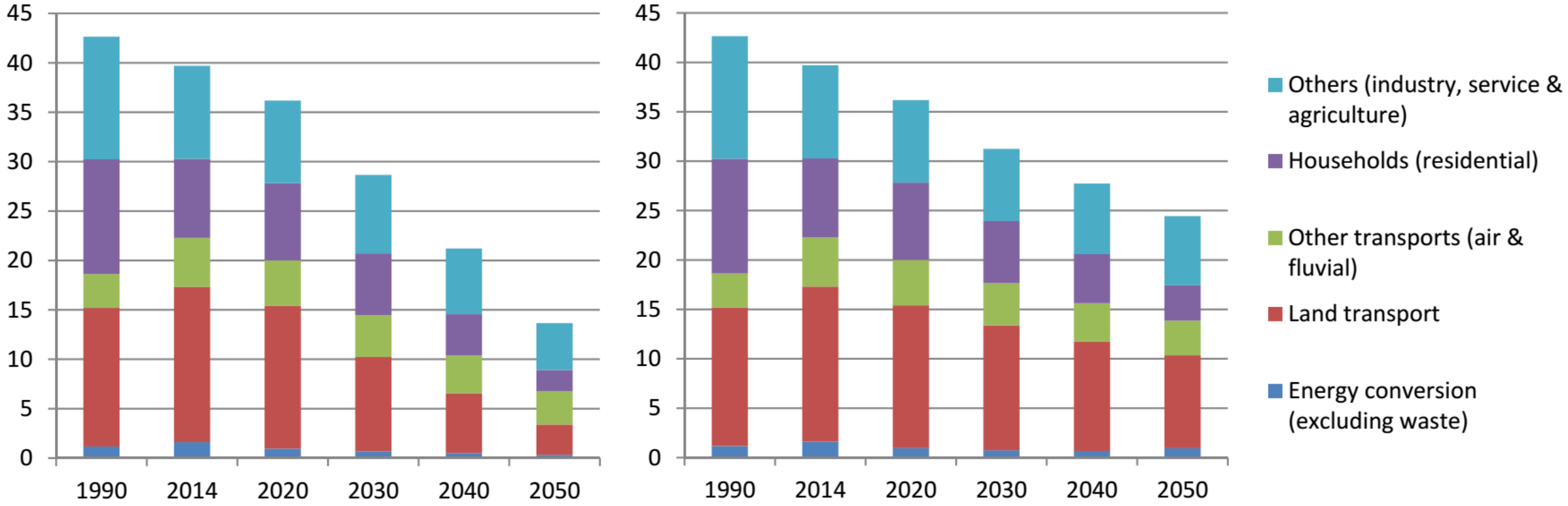
Vielle et al. (2016, unpublished table)

# All sectors must contribute

## $CO_2$ emissions (Mt)

### Decarbonisation scenario
with induced technical progress

### Reference scenario




Vielle et al. (2016, Fig. 2 + 15)



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# The cost depends on technological progress and what the ROW does

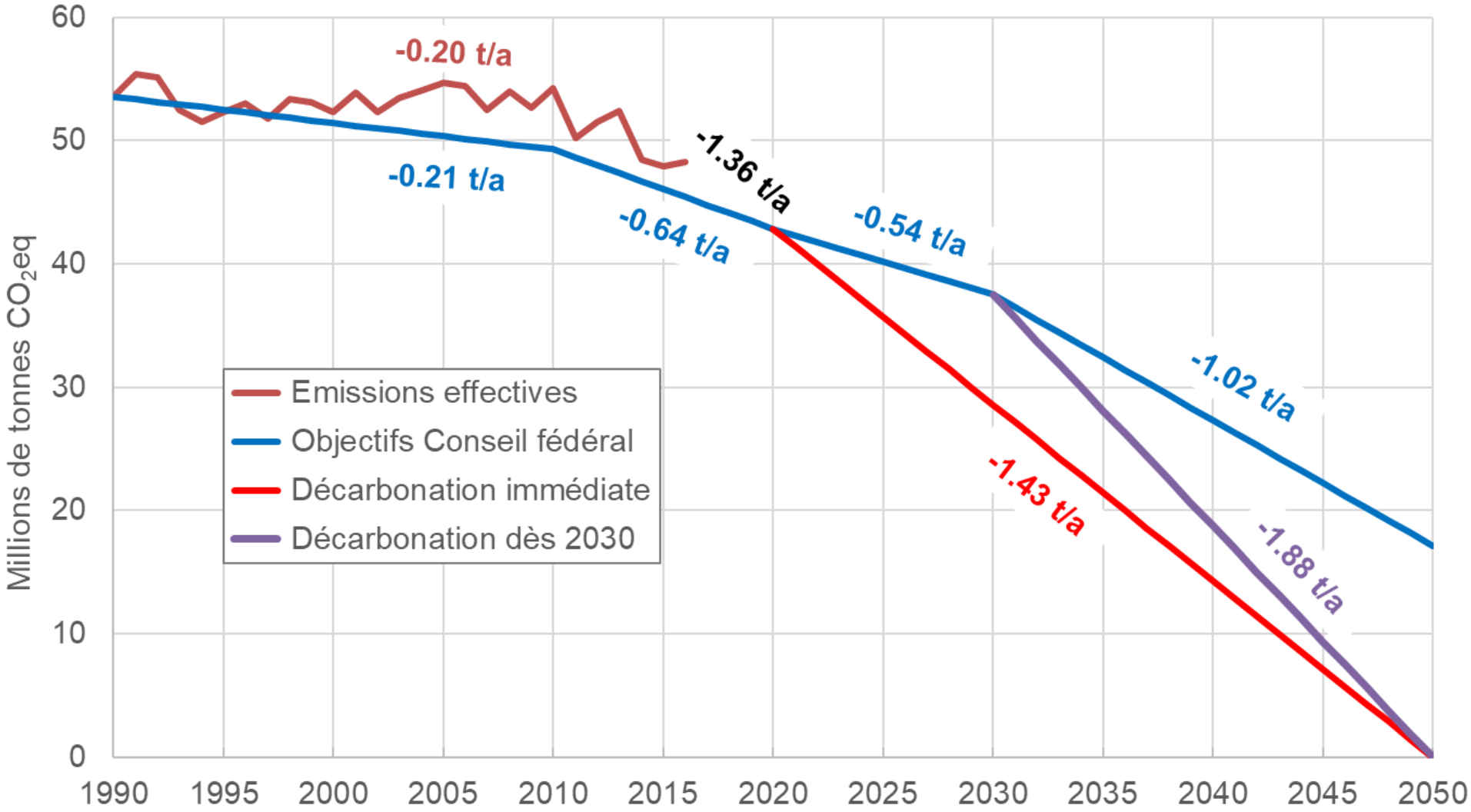
| Swiss deep decarbonization scenarios | Social cost in 2050 (% household consumption, relative to reference scenario) |
|---|---|
| Central (with CCS and induced technical progress) | -0.8% |
| Central without CCS | -1.1% |
| Central without induced technical progress | -0.8% |
| Central with international DDP | -1.3% |

Vielle et al. (2016)

# Is the $CO_2$-Law proposed for 2021-2030 by Federal Council sufficient?

- It is quite doubtful that 2020 target can be met
- Target: -30% in 2030 rel. 1990 implies accelerated decrease after 2030
- Continuation of existing instruments with some tightening
- $CO_2$ tax only for thermal fuels: insufficient
- Cap on $CO_2$ tax at 210 CHF/t will bind if world oil price is lower in 2030 than the expected 139 $USD_{2013}$/barrel
- The tax-exemption mechanism for firms is too lenient and causes high administrative costs

# Swiss GHG emissions reductions needed for different objectives



# Conclusions on Swiss climate policy

- GHG emissions are stabilized since 1970s despite growing population and economy, but little of this is due to climate policy
- Existing and planned measures could lower $CO_2$ emissions by 28% in 2035 rel. 1990, not enough by any criterion
- Objectives in $CO_2$-law are not ambitious enough and not met
- The efforts needed now to meet the 2020 target would lead to 0 emissions by 2050 if continued
- There are not simulations yet of such a decarbonisation path
- Reducing GHG emissions to 1.7 $tCO_2eq$/capita in 2050 is feasible and would cost around 1% of aggregate consumption

# HOW ABOUT THE REST OF THE WORLD?

# Reaching the SDGs is much more likely in a 1.5° world than in a warmer world

Many important results and statements on impacts of CC for developing countries in IPCC 1.5° report:

- Poorer countries are particularly exposed and vulnerable
- +1.5°C means several hundred million fewer people exposed to climate-related risks and poverty by 2050 than with +2°C
- Not only impacts, also mitigation and adaptation are linked to sustainable development
- Some mitigation options pose threats to SD: bio-fuels, BECCS, afforestation
- Good adaptation can foster SD and poverty reduction

# The role of adaptation

- "**A wide range of adaptation options** are available to reduce the risks to natural and managed ecosystems (e.g., ecosystem-based adaptation, ecosystem restoration and avoided degradation and deforestation, biodiversity management, sustainable aquaculture, and local knowledge and indigenous knowledge), the risks of sea level rise (e.g., coastal defence and hardening), and the risks to health, livelihoods, food, water, and economic growth, especially in rural landscapes (e.g., efficient irrigation, social safety nets, disaster risk management, risk spreading and sharing, and community-based adaptation) and urban areas (e.g., green infrastructure, sustainable land use and planning, and sustainable water management) (*medium confidence*)." (SR15, SPM B.6.1)
- "**Limits to adaptive capacity** exist at 1.5°C of global warming, become more pronounced at higher levels of warming and vary by sector, with site-specific implications for vulnerable regions, ecosystems and human health (*medium confidence*)." (SR15, SPM B.6.3)

# Are there adaptation scenarios?

- It is much more common to distinguish varieties of possible measures to mitigate the impacts of climate change:
  - Sea level rise: build dikes, relocate activities
  - Less snow: artificial snow cover, shift tourism activities
  - Droughts for agriculture: build irrigation system, change crops
- "Scenarios" would group such measures by a criterion:
  - "Technology" scenario: dikes, artificial snow, irrigation
  - "Avoidance" scenario: relocation, change activity or crop
  - "Centralized" scenario: the State organizes adaptation measures
  - "Decentralized" scenario: autonomous adaptation by those affected
  - "Proactive"/"Reactive" scenarios: try to avoid damage or prepare to repair
- No one recommends one adaptation scenario: you always need a little of everything

# How can Switzerland help?

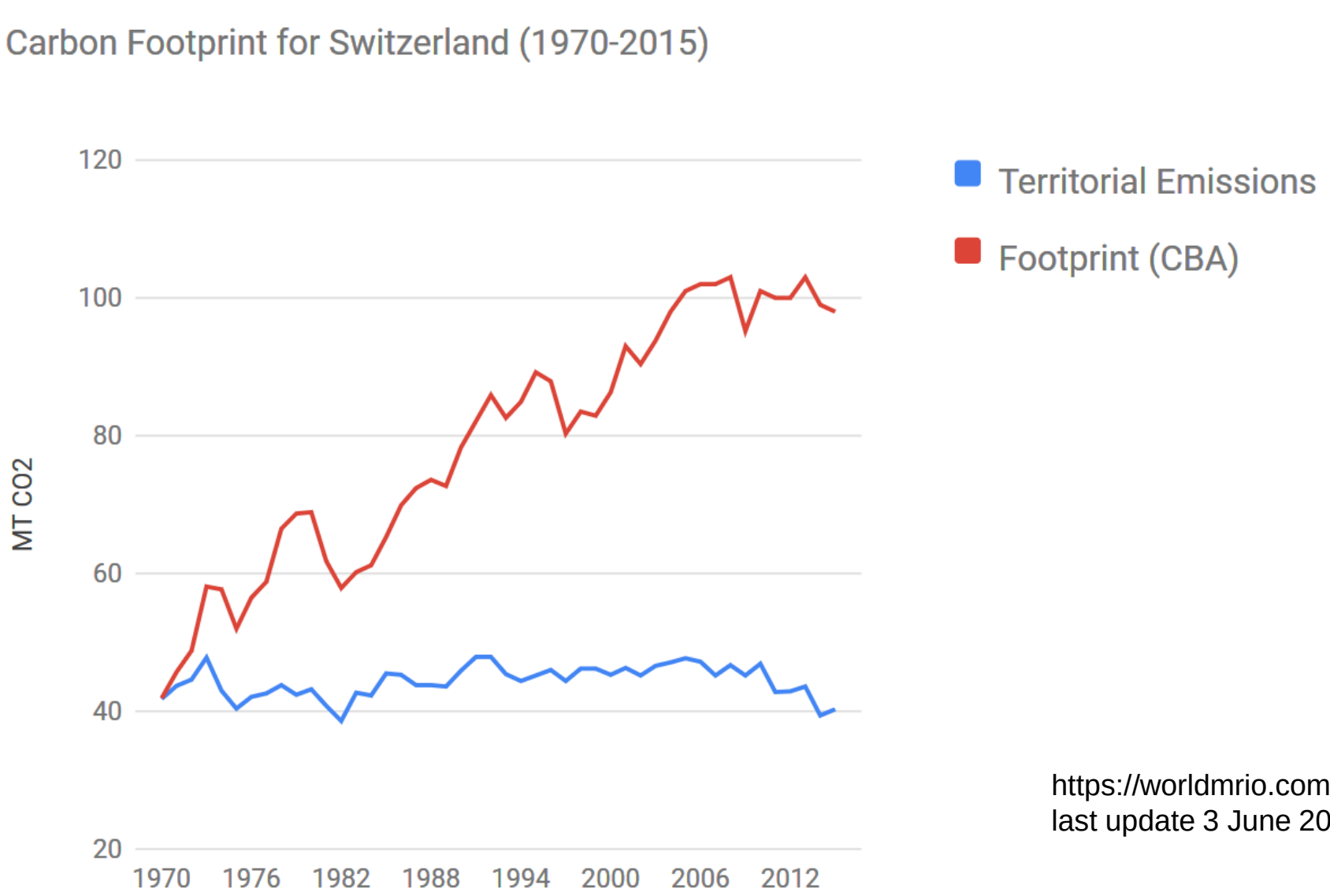
- "**International cooperation is a critical enabler** for developing countries and vulnerable regions to strengthen their action for the implementation of 1.5°C-consistent climate responses, including through enhancing access to finance and technology and enhancing domestic capacities, taking into account national and local circumstances and needs (*high confidence*)" (SR15, SPM D.7.3)
- Switzerland can help with technological but also organizational know-how

# 5 reasons why Switzerland should reduce its GHG emissions without waiting for the World

1. A more efficient economy
2. Cleaner air and other co-benefits
3. Developing exportable solutions
4. Prompting an international response
5. Stewardship: the 39 $MtCO_2eq$ emitted **in** Switzerland (2016) become 100 Mt when emissions **for** Switzerland are estimated

Thalmann, Philippe, "Kein nutzloser Tropfen im Ozean – Sinnvoller Klimaschutz in der Schweiz", *NZZ* 14.11.2007

# $CO_2$ emissions and $CO_2$ footprint of Switzerland




https://worldmrio.com/footprints/carbon/
last update 3 June 2018

# CONCLUSION

# Conclusions

- Every country must get free of fossil fuels and reduce as much as possible its emissions of other greenhouse gases
- The longer it waits, the steeper the path
- High-income, high-tech countries should pave the way
- Pushing firms and households to decarbonize through price signals will call for high taxes … hardly acceptable, hardly doable (even if actual welfare cost is small)
- A 'New Climate Deal' is needed
- Example: decarbonisation of Swiss railway transportation between 1918 and 1950!

# APPENDIX

# References (1)


***Effectiveness of Swiss climate policy***

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***Climate policy targets***

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***Impacts of climate change***

Gonseth, Camille, Philippe Thalmann et Marc Vielle, "Économiser de l'énergie grâce au réchauffement climatique", *La Vie Economique/Die Volkswirtschaft* 90(12), 2017, 39-40

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