



Economics of mitigation in sectors with long-lived capital stock

And implications for climate policies

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Motivation: Is there an economic rationale of a two-tier approach to climate mitigation?

- Two approaches to mitigation currently coexist:
 - Carbon markets (e.g., EU-ETS, CDM)
 - Mitigation programs targeted, in particular, at long-lived capital stock (LLKS) (e.g., CIF)
- Question: Is there a rationale for this two-tier approach?



Outline

1. Why does long-lived capital stock matter for mitigation?
2. Looking backward: Insights from past investments in LLKS projects and networks
3. Looking forward: Challenges regarding incoming investments in LLKS projects/networks
4. Could carbon markets provide a correct signal to developers of LLKS projects/networks?



How long is long-lived capital?

- Capital stock can be disaggregated into subgroups (inspired from Jaccard and Rivers 2007)
 - Capital stock w/lifetime of 5-15 years (e.g., most consumer durables). Decentralized decisions made by individuals, households, ...
 - Capital stock w/15-40 years time horizon (e.g., factories, power plants). More centralized decisions at a higher level – mostly firms
 - Infrastructure w/40-75+ years time horizon (e.g., road or power distribution networks). Decisions mostly centralized – often public
 - Land-use and urban forms, w/century+ time horizon. governed by groups 2 and 3 decisions + other policies
- This presentation focuses on groups 2, 3 and 4.



Long-lived capital stock matters for mitigation

- Roughly 40% of total GHG emissions in 2005 are directly influenced by LLKS (source: CAIT/WRI)
- Most stabilization goals cannot be achieved w/o action on LLKS.

% of mitigation required in non-LLKS sectors to remain on stabilization path			
Global mean temperature increase above pre-industrial level by 2100 (°C)	2030	2050	2100
2.0 – 2.4	> 100%	> 100%	> 100%
2.8 – 3.2	73%	90%	> 100%
3.2 – 4.0	55%	56%	> 100%

Source : IPCC, 2007 ; Author's calculations

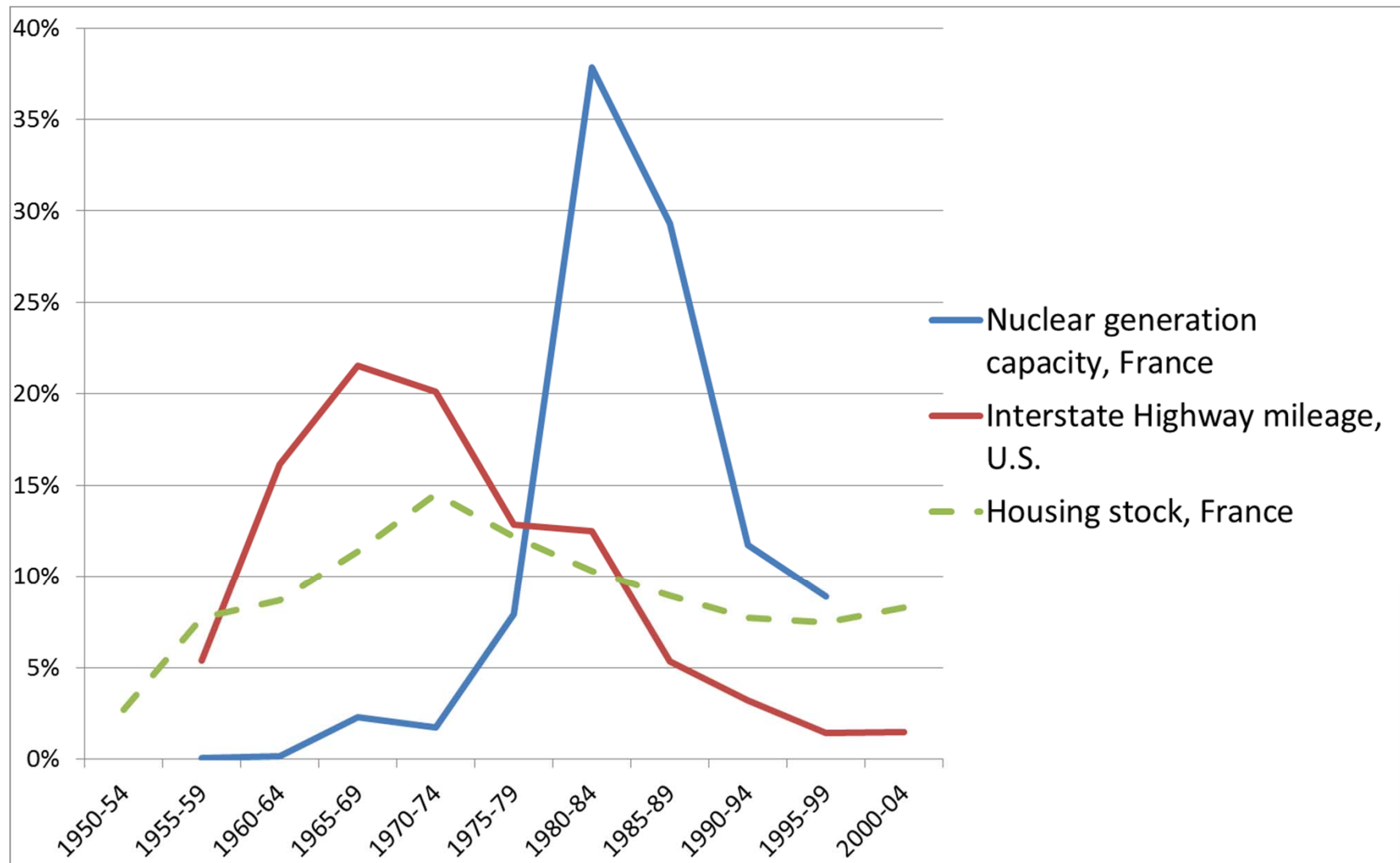


History reveals LLKS investments tend to be lumpy

- Historical examples show that networks or systems of LLKS have high fixed costs and often—but not always—tend to be installed in short periods of time (**lumpiness**).
- Yet the emissions associated with these networks last for much longer periods of time



Lumpy installation in three LLKS programs (capacity installed in 5-year period as share of total capacity)





Various rationale for lumpiness

- Economics of scale (e.g., French nuclear program)
- Distributional considerations (e.g., U.S. Interstate Highway)
- Historic/demographic shocks (e.g., post-war reconstruction)



History reveals importance of indirect and induced emissions

Indirect emissions: Choice of technology for the initial project in a network influences the choice of technology—and thus emissions—in subsequent projects within the same network

- Example: Artery roads linking to U.S. Interstate Highway system
- Causes: e.g., increasing returns to scale, learning by doing, or elements of technological change that lock-in rather than mitigate



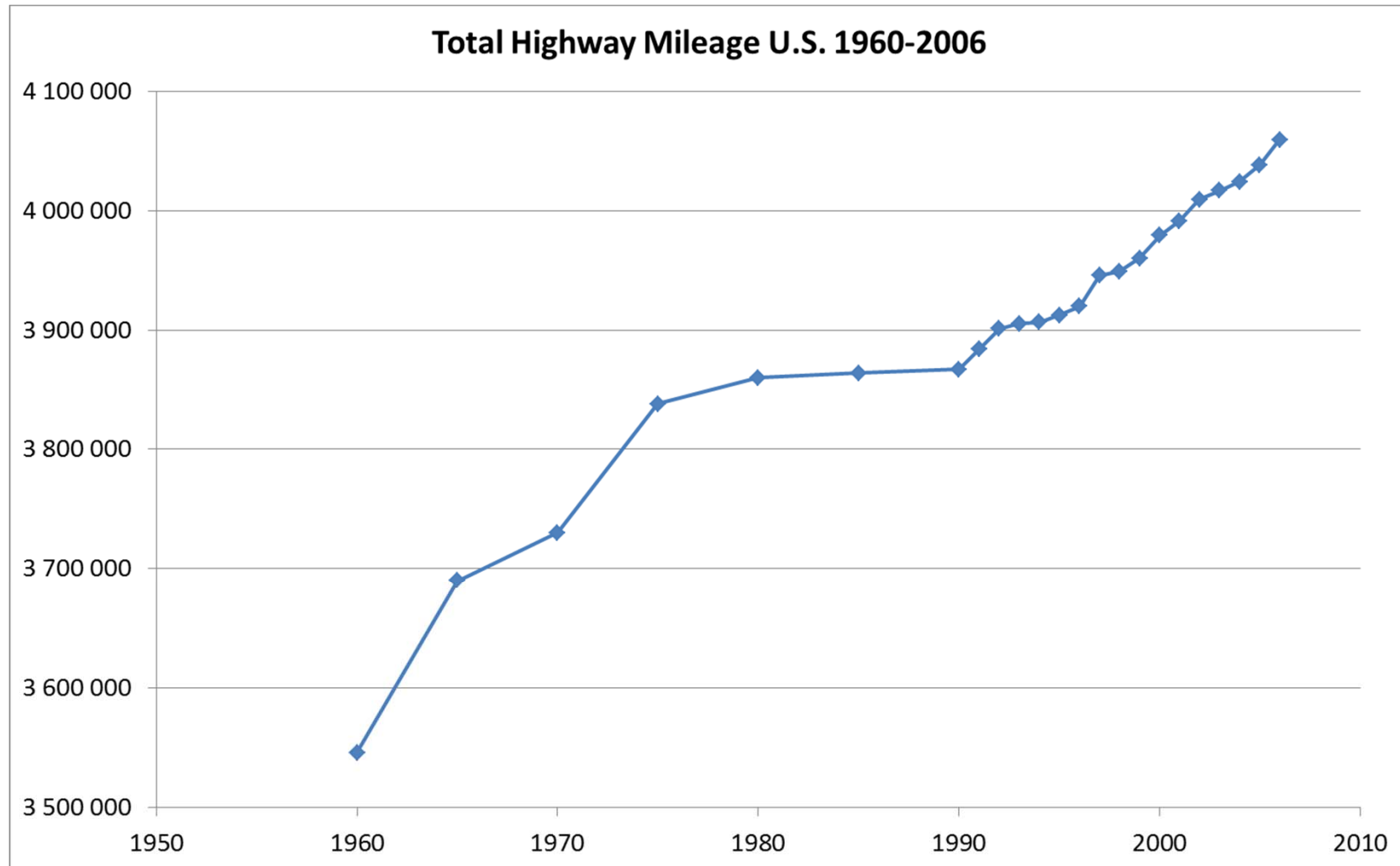
History reveals importance of indirect and induced emissions

Induced emissions: Networks can induce the development of new extensions or end uses not formally part of the original program—possibly inducing additional emissions

- Example: The U.S. Interstate Highway System made it possible to expand cities beyond the core
- Example: Development of electric domestic heating in the wake of France nuclear program



Example: The U.S. Interstate Highway System made it possible to expand cities beyond the core





History reveals importance of indirect and induced emissions

Historical examples suggest that indirect and induced emissions can be significant. But data and/or modeling tools are lacking in many cases

→ Major research challenge



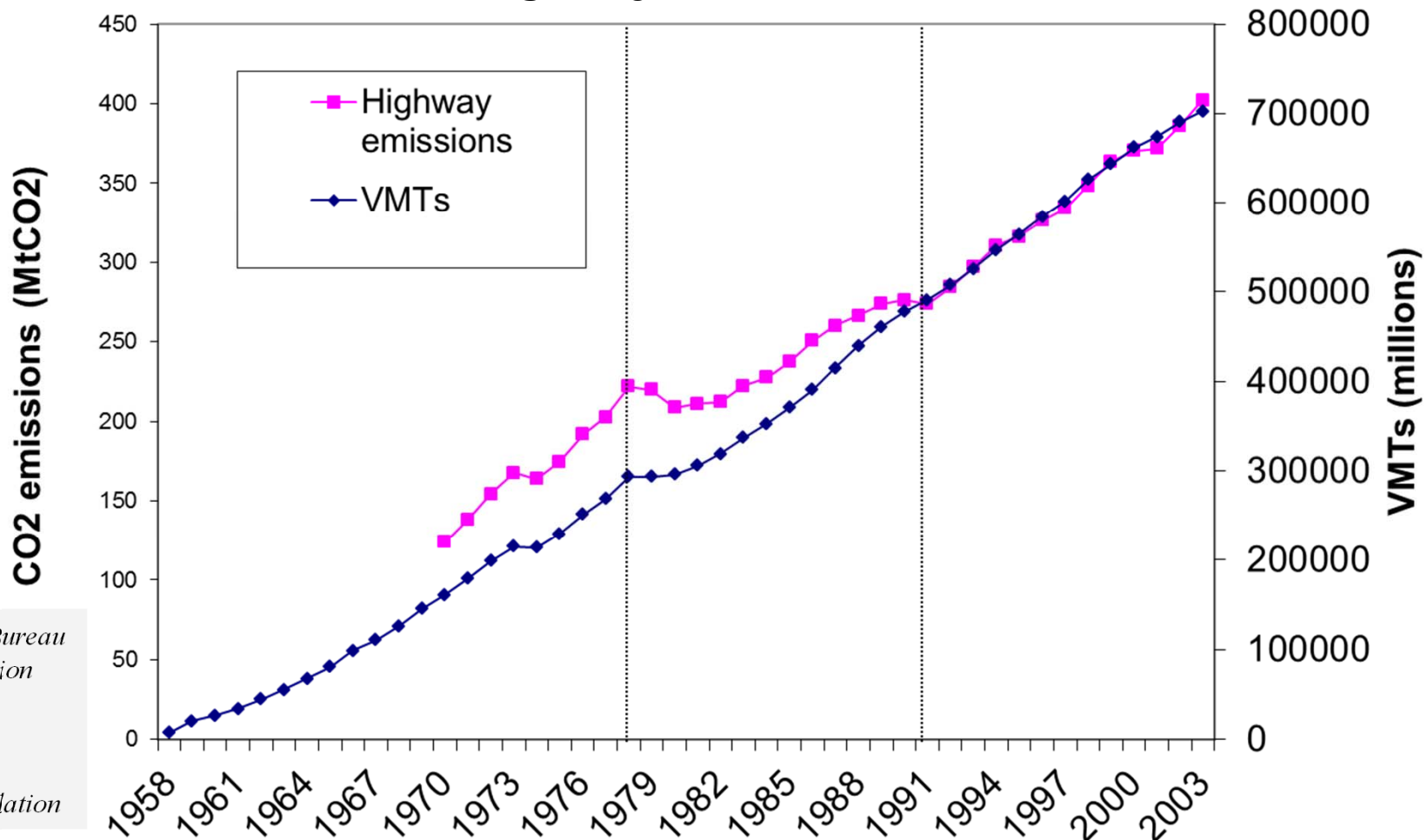
Lumpiness also apply when emissions are not directly linked to LLKS technology

- With supply-side LLKS (e.g., power plants), emissions are directly linked to LLKS technology
 - Once a technology is implemented, emissions are irreversibly locked-in (barring retrofits such as CCS)
- In other cases (e.g., transportation), emissions depend on K stock with shorter life-duration (cars). The infrastructure influence emissions indirectly.
 - Thus improvements in energy (or emissions) efficiency in end-use technology mitigate some of the influence of LLKS
 - Yet barring radical changes in end-use technologies, the structure of the LLKS still matters



Note: Historical examples also pinpoint indirect impact of LLKS on emissions

Vehicles Miles Traveled and CO2 emissions from U.S. Interstate Highways 1958-2003



Source: U.S. Bureau of Transportation Statistics, Lee Schipper (comm.pers.), authors' calculation



Many large-scale investment programs in LLKS loom over the horizon in developing countries

- Two major logistic-shaped drivers: Urbanization and Globalization
- Well-known examples include transportation, energy and housing in China and India
- Most LLKS in developing countries remains to be built
 - Whereas most LLKS in developed countries has already been built.
- It might thus be possible to “grow out” of the risk of lock-in by reorienting investments now towards low-emissions options—avoiding costly retrofits or premature retirement down the road
- But, akin to their historical counterparts, new LLKS investment programs are likely to be lumpy: Hence, the window of opportunity is likely to be narrow



Implications for climate policies: A sketch of the argument

- Current C markets are limited in time/scope
 - Even extended C markets would not price indirect/induced emissions
 - Even pricing indirect/induced emissions would not eliminate need for large upfront financing
 - Lack of financing is only one of multiple barriers faced by low-emissions LLKS alternatives
- Hence the need ‘targeted mitigation programs’



Directions for future research

- Can induced and indirect emissions related to particular LLKS project/network be estimated ex ante?
 - Some models/empirical analysis exist, but limited
 - Case studies of historical examples may provide useful insights.
- How should ‘targeted development programs’ be designed?
 - Reinforces the need for explicitly incorporating development objectives into the climate change agenda



Reference

Shalizi, Zmarak, and Franck Lecocq. 2009.
Climate change and the economics of targeted
mitigation in sectors with long-lived capital stock.
Policy Research Working Paper 5063,
Washington D.C.: World Bank, 41p.



Thank you for your attention

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