RESEARCH AND DIALOGUE

FOR SUSTAINABLE SOCIETIES

Low-carbon technologies:

Diffusion vs. Transfer

National actions and international cooperation

Silvia Weko

Based on forthcoming paper: **Bridging the low-carbon technology gap? Assessing energy initiatives for the Global South**

What is technology transfer?

"**learning to understand, utilize, and replicate the technology**, including the capacity to choose it and adapt it to local conditions and integrate it with indigenous technologies" (IPCC 2000, pp. 3).

Technology diffusion vs. technology transfer

Diffusion: hardware is adopted in a new location

Transfer: local knowledge and skills increase

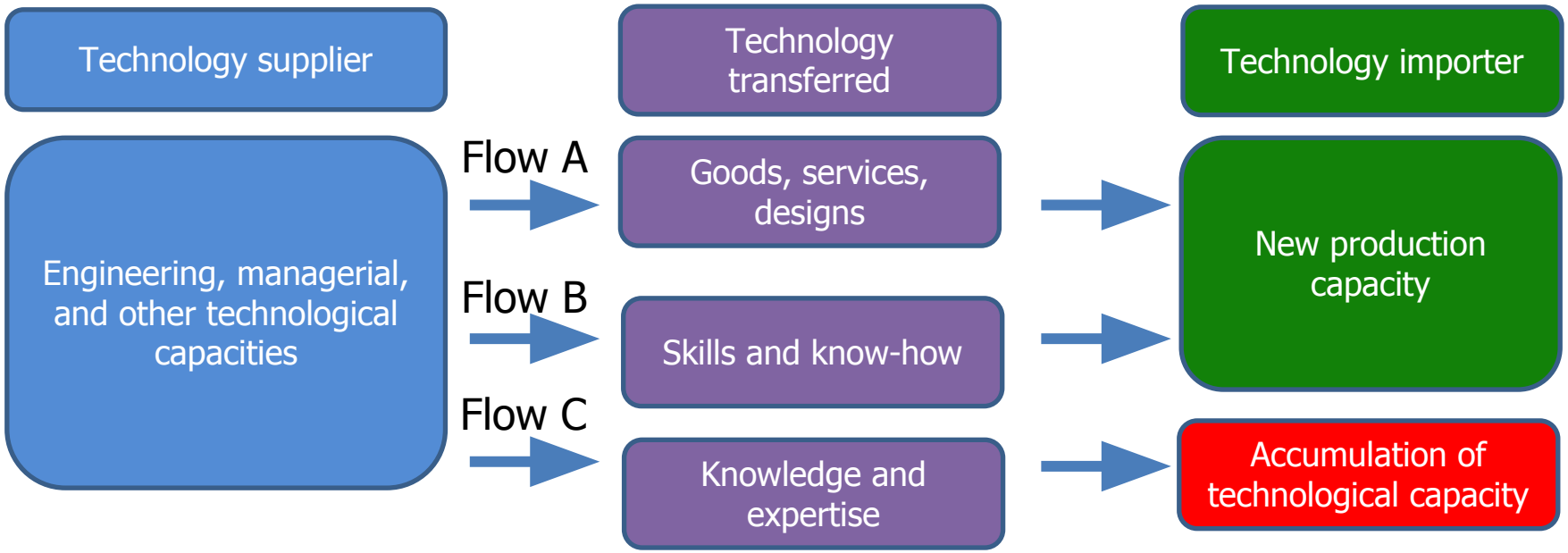
☐ higher development + (long-term) emissions reduction potential

Closing the low-carbon technology gap

- Intellectual property rights (IP) + highest-value activities concentrated in OECD, China
- Historical responsibility + justice issues
- Obligation to encourage tech transfer to developing countries under TRIPS (Art. 66.2) & Paris Agreement

International technology transfer in theory

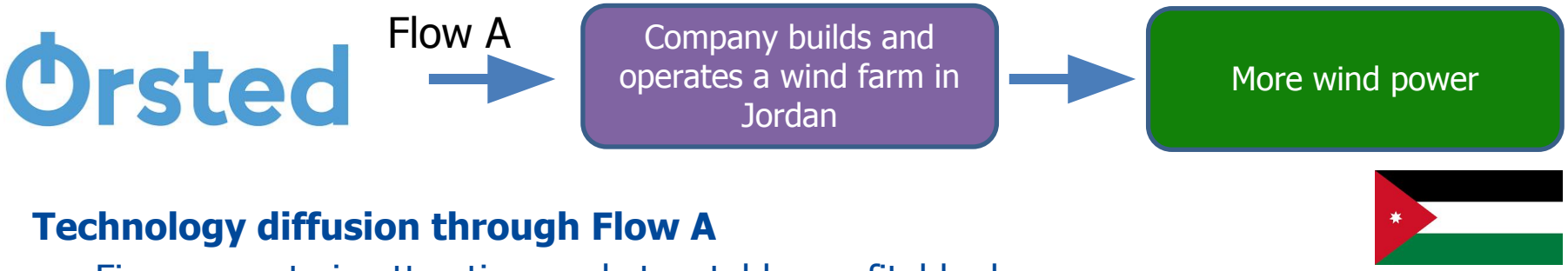
Ockwell et al. 2010, based on Bell 1990



International tech transfer: solar PV technology

- First-mover advantage EU
- China as a success story: leader in manufacturing and installment, now research and development
- Most other developing countries use but do not produce technologies

International technology transfer: flow A



Technology diffusion through Flow A

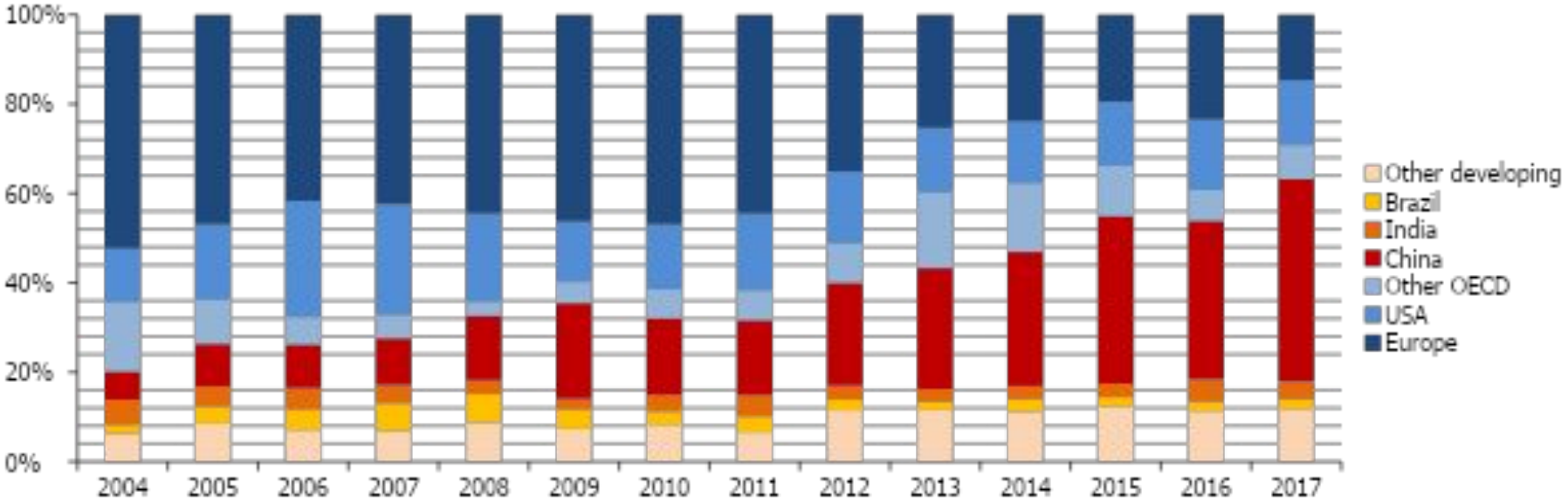
- Firms operate in attractive markets: stable, profitable, large

Technology supplier	Technology importer
+ New markets and profits	+ New energy source + Rents from land use (often low) + Low-skill jobs: some construction, security, cleaning - Can't do own O&M, adapt to local conditions - Potential for failure and backlash

International technology transfer: flow A

Left out of flow A: risky environments (e.g. political or economic instability), unattractive markets (low demand, infrastructure issues, weak property rights protections)

Global new investments in renewable energy, share of total



Potential solutions:

- Increasing attractiveness: de-risking, demand aggregation, improving infrastructure
- Generally: more funding for international mechanisms

International technology transfer: flow B

Ørsted

Flow A+B →

Company builds a wind farm in Jordan, hires locals to operate and maintain it →

More wind power + ability to fix it if something goes wrong

Technology diffusion through Flow A+B

- Firms train and hire some locals if they have sufficient skills, for operation and maintenance of installations
- Firms go where there is little risk of losing control of value creation: property rights protections, fewer chances for reverse engineering and imitation

Technology supplier	Technology importer
+ New markets and profits	+ Sustained use of new energy source: how to integrate it into a system + Higher-skilled jobs

International technology transfer: flow B

Left out of flow B: countries with lower-skilled workers, issues with property rights protections

Figure 5: Solar PV employment: Top 10 countries

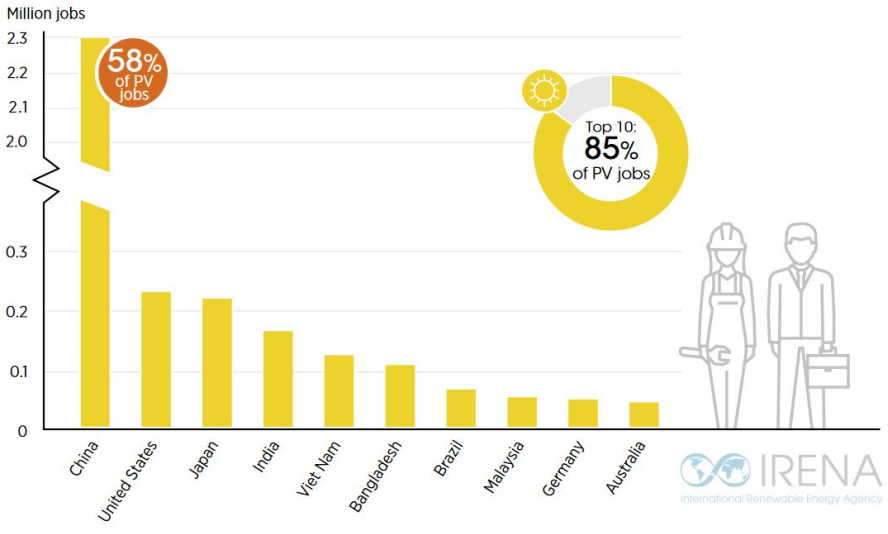
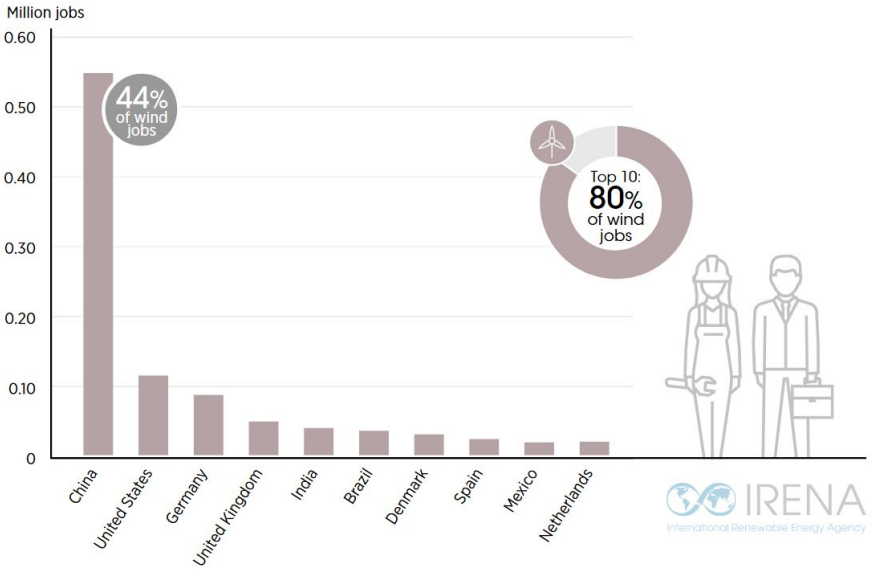


Figure 7: Wind employment: Top 10 countries



Source: IRENA jobs database.

Potential solutions:

- Training and capacity-building programs
- Policy changes: some (low-risk) requirements for training and employment, *increasing property rights protections (?)*

International technology transfer: flow C

Technology transfer is possible IF:

- Local firms have *high absorptive capacities*
- Local firms are involved in processes requiring knowledge and expertise (e.g. manufacturing solar panels)
  - IF: government requirements
  - AND: cooperation benefits firm

Technology supplier	Technology importer
+ New markets and profits - New competitors, losing market share	+ Accumulating technological capacity + Developing new industry and innovations - Potential to lose attractiveness - Potential for trade conflicts

International technology transfer: flow C

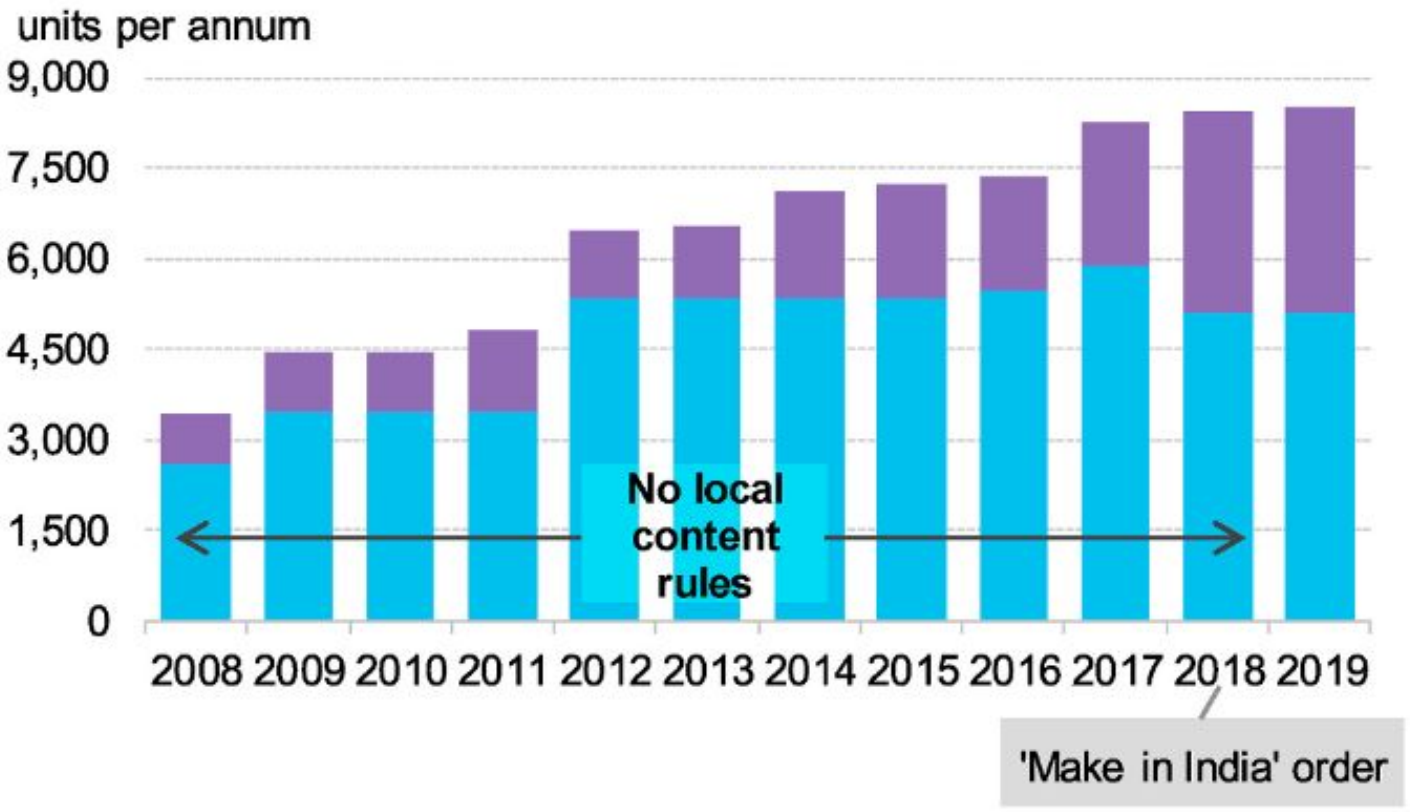
Policies to 'force' tech transfer

- **Joint Ventures:** foreign firms must form legal relationships and transfer technology
  - "Negative list": strategically important technologies, Chinese shareholders at 50% or above
  - Solar and wind energy on this list until 2011
  - Electric vehicles phased out 2022

- **Local Content Requirements**: developers must use a certain percentage of local products
  - Common around the world: EU, North America, MENA region, South America
  - Often tied to funding (FiT eligibility)

The problem with local content requirements

Wind Manufacturing Capacity
Purple = foreign, blue = domestic



Doesn't always work to build industry (see Bazilian et al., 2020, Behuria 2020)

Efficiency issues: can make installations more expensive

Trade conflicts: US – EU – China disputes over LCRs at the WTO

Fostering tech transfer: International debates

	Technology holders	Technology importers
Position on IPRs	• Property rights regime incentivizes firms to invest in innovation ☐ technological advances for all • Countries with stricter IPR protections are more attractive for FDI because it lessens the threat of imitation ☐ increasing tech diffusion	• Risk of patent thickets (needing to acquire different expensive IPRs) ☐ blocks technological advances • IPRs allow firms to monopolize knowledge that can be life-saving • 'Global North' firms mostly owns these IPRs, but have lower climate risks + high historical responsibility
Prioritizing	Diffusion: spread (existing) tech as quickly as possible	Transfer: enable clean development pathways
Proposed solutions	• Patent pledges • Flexible and affordable licensing	• Put low-carbon technology in the public domain • TRIPs waivers and licensing exceptions

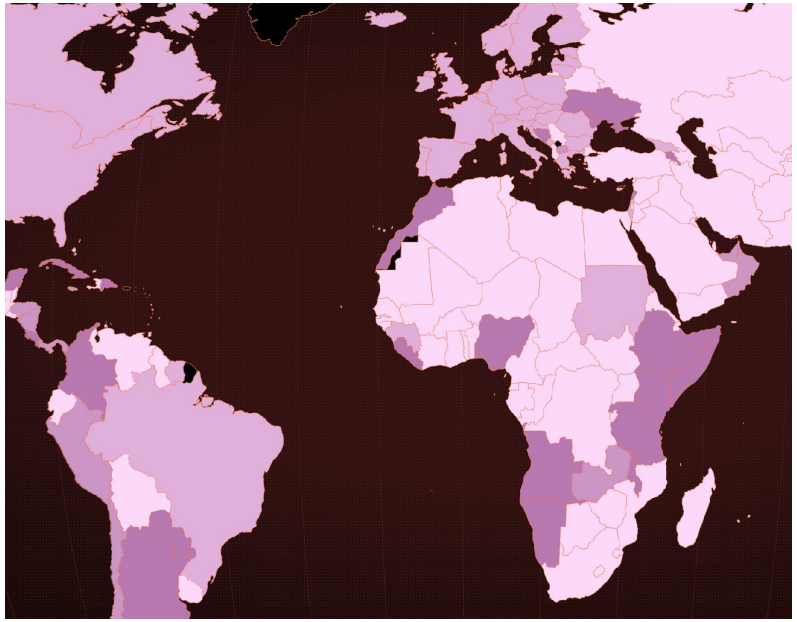
Fostering tech transfer: international mechanisms

At the UNFCCC

- Clean Development Mechanism (CDM)
- Conditional Nationally Determined Contributions (NDCs) depend on tech transfer

UN technology mechanism

- Technology Executive Committee: guidance and roadmaps
- Climate Tech Center and Network: technical assistance for developing countries
- Financed by GEC, GCF



NDC explorer: (purple) NDCs conditional on tech transfer

Developing a national policy for deploying and scaling up E-mobility and supporting sustainable infrastructure in Papua New Guinea

Fostering tech transfer: international mechanisms

International organizations and development banks

- Information and training
- Project finance: installation, infrastructure, small-scale electricity access initiatives
- Often development-focused, some local training
- *Climate Innovation Centers (CIC):* all-around support for SMEs in emerging economics (Ghana, Vietnam)

Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS): Article 66.2

- Developed countries incentivize their firms and institutions to promote tech transfer to LDCs – including low-carbon tech
- Must submit annual reports on their article 66.2 activities
- **Critiques:** not targeting LDCs, vague or inaccurate tech transfer definitions (e.g. UK funding drug research that could benefit the developing world)

Summary

- **'Green industrialization'** requires tech diffusion + transfer
- IPRs **are not** the main barrier to tech diffusion
- IPRs **may be** a barrier to tech transfer if costly, create patent thickets etc.
- **Increasing tech diffusion:** increasing attractiveness for investment in RE installations through public/donor mechanisms (de-risking, infrastructure)
- **Increasing tech transfer:** against interests of technology-holders, whose competitive advantages come from innovation
  - **Option 1:** Tech recipients increase requirements
    - local content requirements
    - limited to large, attractive markets like China
  - **Option 2:** Developed countries increase requirements on (own) firms:
    - obligating own firms to do more for skills-sharing + localization
    - keeping IP protections short-term, regulating against patent thickets

Get in touch!

Investigating the systemic impacts of the global energy transition (ISIGET) project
IASS Potsdam

Silvia Weko
Research Associate
silvia.weko@iass-potsdam.de
@SilviaWeko

Prof. Dr. Andreas Goldthau
Research Group Leader
Andreas.goldthau@iass-potsdam.de
@goldthau

SPONSORED BY THE
Federal Ministry
of Education
and Research

Further materials

About us

IASS POTSDAM

SPONSORED BY THE

Federal Ministry of Education and Research

Research Group: The Energy Transition and the Global South

- "Investigating the Systemic Impacts of the Global Energy Transition": funded by French and German governments (2019-2022)
- Interested in challenges facing developing countries, risk of uneven transition

Research streams:

- Trade-climate linkages (Border Carbon Adjustment)
- Energy justice
- COVID-19 impacts
- Attitudes towards climate and energy
- Qualitative case studies: 2050 transition scenarios in Jordan, Malaysia, Kenya and Chile

Low-carbon tech transfer research

Success stories: tech transfer through FDI and trade

- China: solar and wind industry 'green industrialization'
- Chile, Brazil: wind tech transfer due to demand + pre-existing knowledge base + policy
- India: tech transfer via CDM + demand + policy – but 'late' to game
- South Africa: local content requirements unsuccessful

Technology transfer through the Clean Development Mechanism (CDM)

- Follows general trends and existing relationships (China, India, Brazil)
- Around 5% in Africa
- "Technology transfer" listed in projects is not necessarily 'transfer' per se

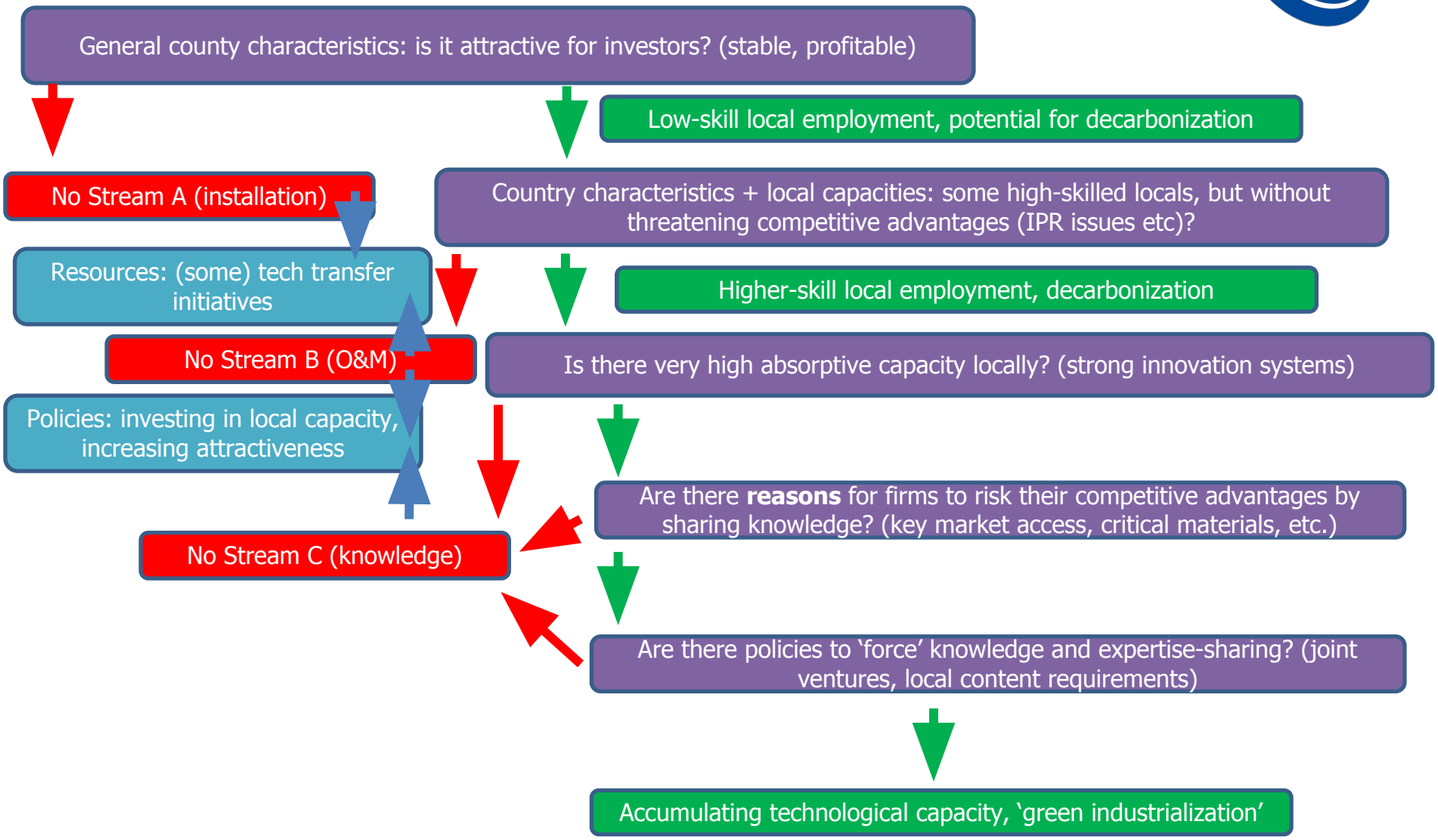
South-South exchange

- North-South imbalances could make South-South transfer more appropriate?
- Not necessarily: role of China and build-operate-transfer contracts

Intellectual property rights?

- Blocking vs. encouraging technology transfer

Tech transfer possibilities



Summary

Technology importer	Transfer streams	Development and climate potential	National policy options	International community options
Markets perceived as high-risk, low reward: instability, small	Will not arrive through the private sector. Alternatives are (some) tech transfer agents like the CTCN, MDBs	Low: tech transfer initiatives are only a drop in the bucket	Improving attractiveness (e.g. infrastructure investments) Connect to intl resources (UN, IRENA, banks)	Funding and support for higher-risk countries (de-risking, grants to MDBs etc.)
Somewhat attractive markets: smaller but nevertheless profitable	Transfer stream A: installment will increase, but no large structural changes	Medium/low: reducing emissions, but mainly low-skill short-term jobs without transfer	As above	As above Potentially: pressure on tech exporters (like Orsted) for CSR
Attractive markets: tech exporters are willing to make some concessions for access	Transfer stream A+B: installment increases, potential for structural changes	Medium/high: reducing emissions, new jobs in operation, maintenance, installment	Investing in local capacities Requirements on exporters (jobs training, local employment) Connect to intl resources	As above
Very attractive markets: tech exporters will make significant concessions for access	Transfer stream A+B+C	High: reducing emissions, new industry emerges that can eventually push policy	Investing in capacities + local content requirements and joint ventures	Preventing trade conflicts