Building pathways towards low-carbon transport systems: the “Data to Deal” (D2D) Approach

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Climate Compatible Growth

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“The views expressed in this material do not necessarily reflect the UK government’s official policies.”

University Partnership:

University of Cambridge | The Open University | Climate Parliament | University of Strathclyde Glasgow | Imperial College London | Centre for Global Equality | University of Oxford | Loughborough University – STEER – Centre for Sustainable Transitions: Energy, Environment and Resilience | KTH Vetenskap och Konst | UCL

Contents/scene-setting

- **Eyes on the prize:** D2D and concessional finance
- **D2D and the avoid-shift-improve hierarchy:** Costa Rica and Lao PDR
- **Improving data at scale:** the Transport Data Commons
- **Future directions:** CCG and OSeMobility, the open-source mobilities model

Eyes on the prize

Eligibility criteria for concessional financing – GCF

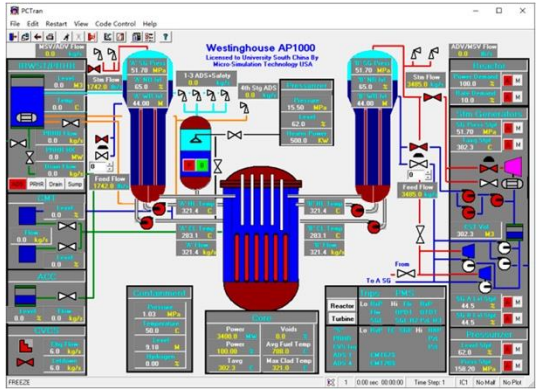
1. Country Alignment: Proposals should **confirm alignment** of the activities with host country priorities, including its nationally determined contribution (NDC).
2. **Quantification of GHG mitigation**
3. Additionality

Example: ADB-Bus Rapid Transit System in Karachi, Pakistan

What are the key *complexities* in transport?
What does this mean for D2D?

- Transport transitions entail **complex** links between policy, infrastructure and behaviour change
- This means that **returns are very uncertain**
- **Emissions impacts are hard to measure** – what's the baseline?

- **Complicated:** lots of interactions, but the unknowns can be (with a lot of analysis) known
- **Complex:** there are known unknowns, and unknown unknowns!

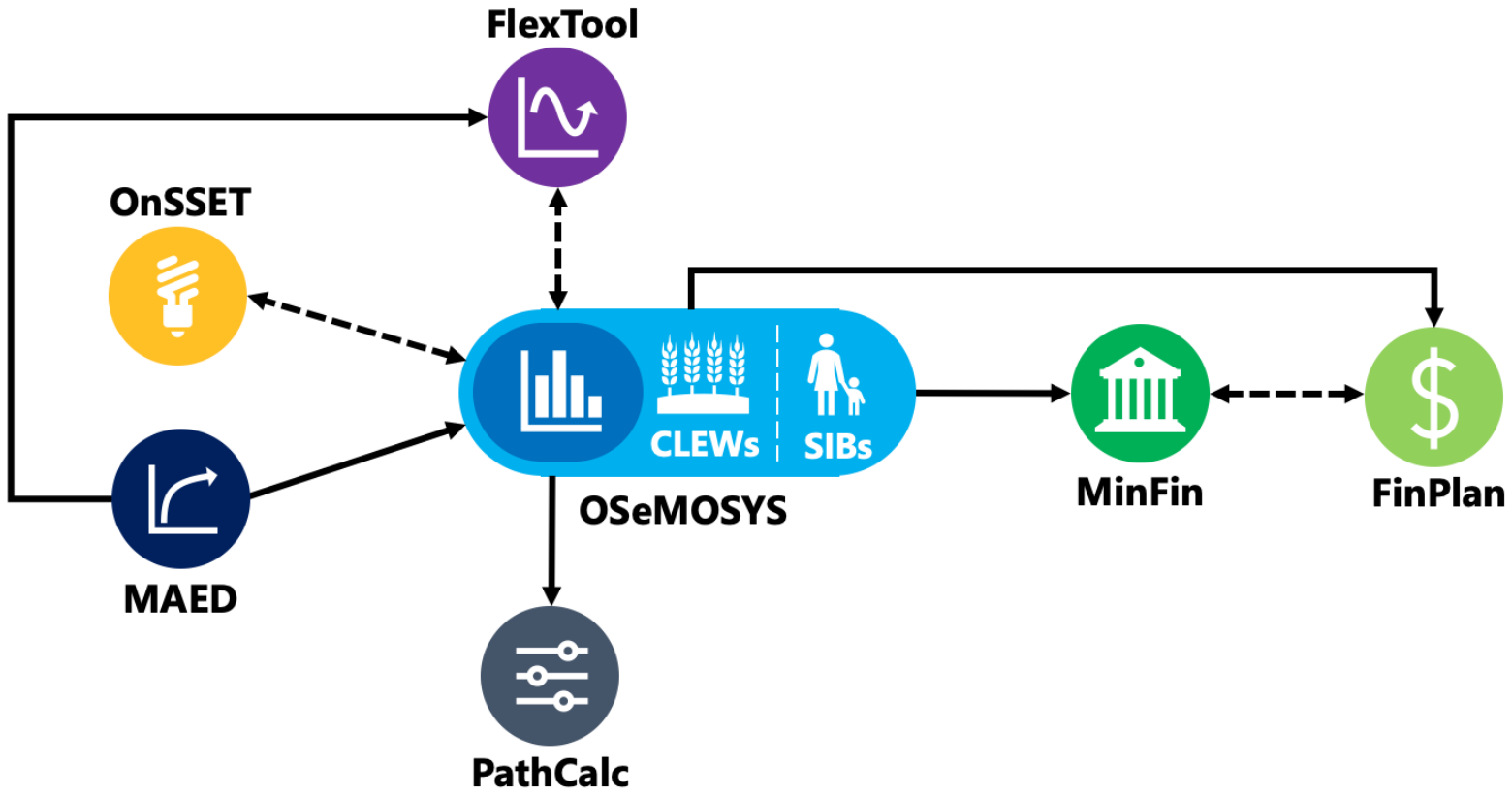


Complicated: a nuclear reactor

Complex: a transport system

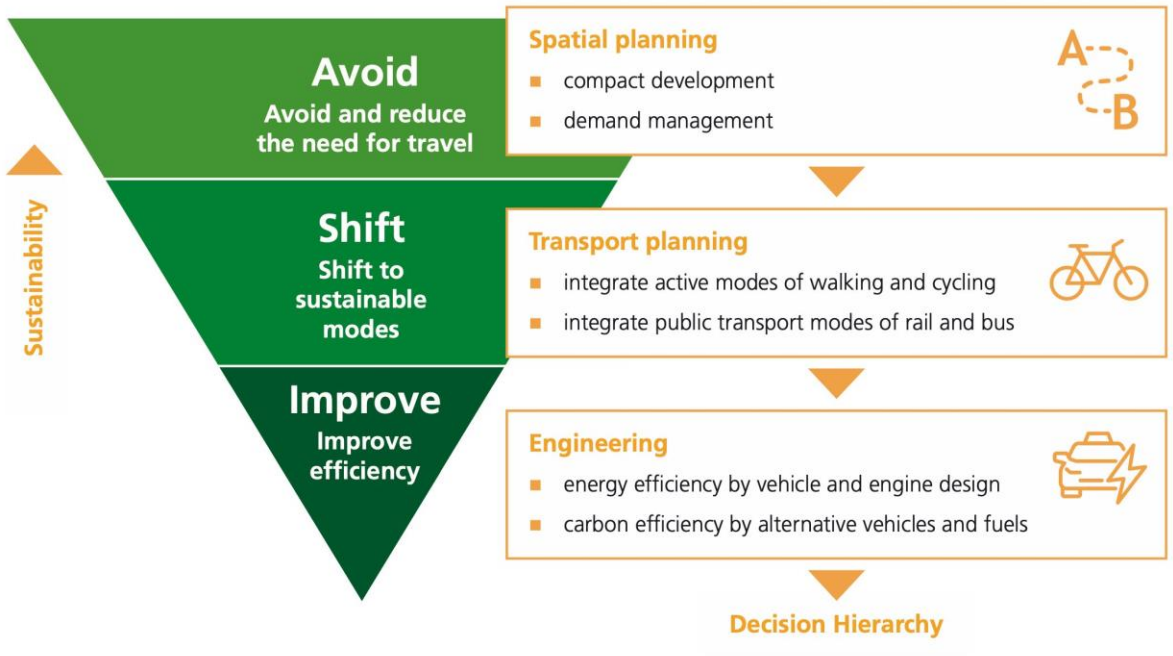
Data-to-Deal

The Analytical Workflow



Building decarbonization pathways

Avoid, shift, improve

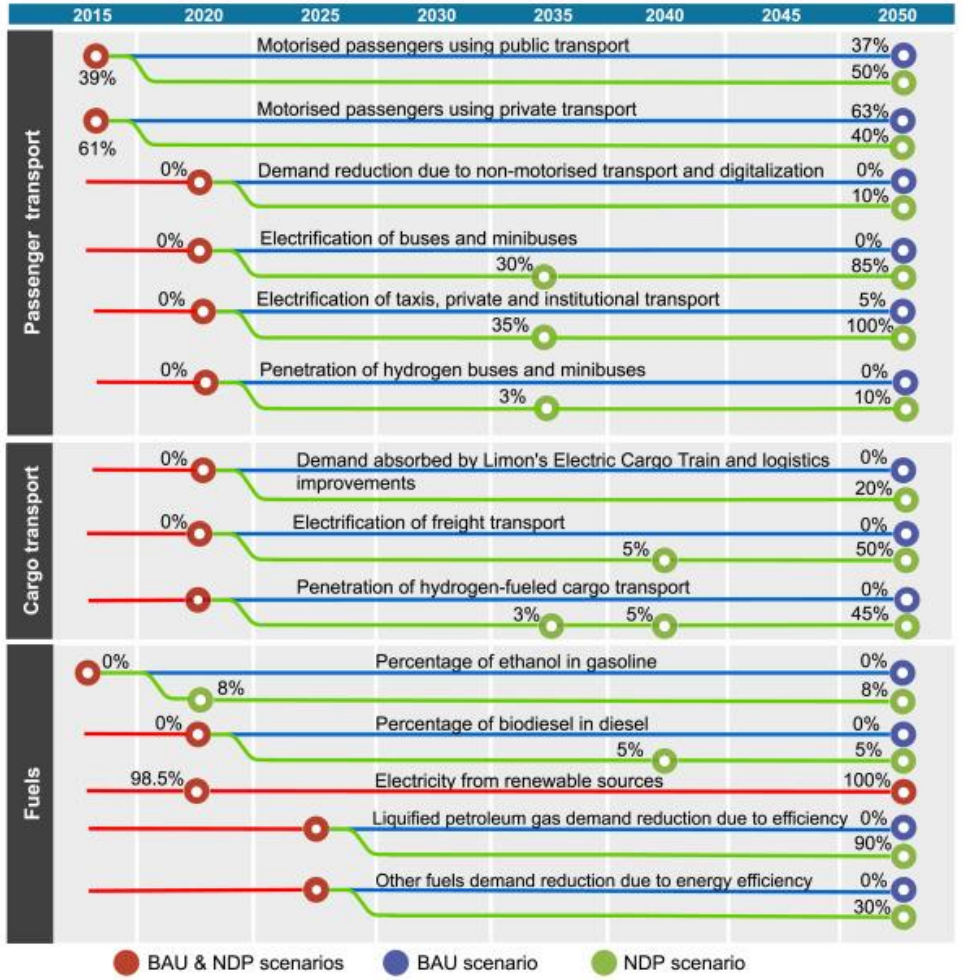


Environmental Protection Agency (Ireland)

- The Avoid-Shift-Improve hierarchy is a framework for **sustainable transport**
  - Avoid = ***reduce demand*** for transport
  - Shift = ***move demand*** to low-energy modes
  - Improve = ***improve efficiency*** of technologies

Implementing A-S-I & T levers in a model
Costa Rica D2D Study (2020)

- **Modelled scenarios** based on co-designed narratives describing possible futures
- Using those scenarios for **informed policy dialogue** is a building block for designing a **long-term strategy** (LTS)[1]
- A key objective of the **model** is to **quantify transformations over time in physical terms** (e.g. % renewable energy, CO_2 emissions, modal share of rail)
- **Open models**, **open data** and **peer-reviewed, transparent workflows** allow for a level of **community-based accountability**, thus increasing the credibility of the work

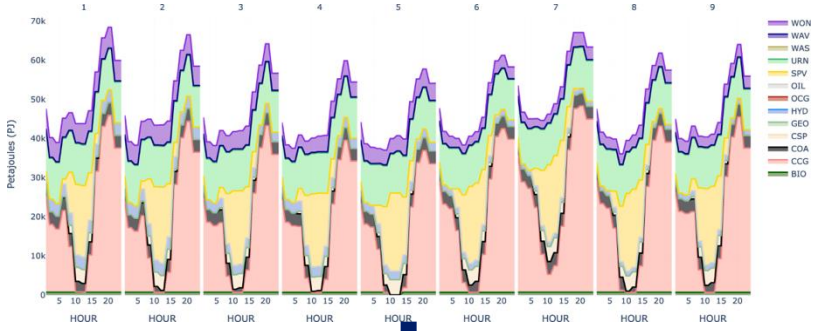


Godinez-Zamora, G., et al. (2020). Decarbonising the transport and energy sectors: technical feasibility and socioeconomic impacts in Costa Rica. *Energy Strategy Reviews*. Vol. 32. https://doi.org/10.1016/j.esr.2020.100573

[1] 2050 Pathways Platform (2017). 2050 Pathways: a handbook.

Costa Rica's National decarbonization Plan

Mobilisation of $2.4bn for decarbonization



Modelling informs **robust strategies**

DECARBONIZING COSTA RICA

NATIONAL DECARBONIZATION PLAN | GOVERNMENT OF COSTA RICA 2018 -2050

COSTA RICA BICENTENNIAL GOVERNMENT

Source	Funds (USD)	Instrument	Objectives
IDB	45,000	Grant – Technical Cooperation	LTS design – Modelling and policy analysis[35]
IDB	230 million	Programmatic Policy Base Loan	CR-L1142: Towards a Green Economy: Support for Costa Rica's Decarbonization Plan I. Policy and regulatory reform in energy, transport, agriculture, and ecosystem sectors. As well as within national economic planning processes and fiscal and budgetary policy[37]
IDB	500,000	Grant – Technical Cooperation	CR-T1217: Strengthening the Management and Monitoring of Climate Action. To support achieving policy commitments related to climate management and monitoring defined under PBL CR-L1142[38]
IDB	450,000	Grant – Technical Cooperation	CR-T1224: Support for the Strategy of Strengthening Mass Public Transport of People by Bus. Including support for the implementation of the public transport electrification project and electronic payment system. To support achieving policy commitments under the PBL CR-L1142 and CR-L1139[39]
IDB	850,000	Grant – Technical Cooperation	CR-T1218: Support for policy reforms and implementation of Nature-Based and Climate-Smart Agriculture Solutions that contribute to Costa Rica's National Decarbonization Plan[40]
IDB	220,000	Grant – Technical Cooperation	CR-T1219: Support for the Transformation of the Energy Sector towards a Decarbonized Economy as per the NDP to support achieving policy commitments under the PBL CR-L1142[41]
IDB	400,000	Grant – Technical Cooperation	CR-T1240: New Skills for the Agriculture of the Future. Develop a proof of concept of a "bootcamp" in agricultural technical high schools so that education in agriculture can adapt to the new demands of the labour market[42]
IDB	500,000	Grant – Technical Cooperation	CR-T1239: Support for the Development of the National Hydrogen Strategy towards a Decarbonized Economy, in line with the Decarbonization Plan[43]
IDB	300 million	Programmatic Policy Base Loan	CR-L1147: Towards a Green Economy: Support for Costa Rica's Decarbonization Plan II. USD 250 million in ordinary capital from the IDB, plus USD 50 million from the Government of Korea. Loan to continue to back Costa Rica's NDP. This loan is the second in a series of two programmatic policy-based lending operations[44,45]
IDB	400,000	Grant – Technical Cooperation	CR-T1259: Support for the implementation of the "Towards a Green Economy II" Program (CR-L1147). To complement the Decarbonization Plan reform actions in relation to Nature-Based Solutions and Agriculture. [46]
IDB	350,000	Investment Grant BID Lab	CR-G1010: Circular Economy from Agroforestry Residues for Decarbonization[47]
AFD	150 million	Policy-based loan	Policy and regulatory reform in energy, transport, agriculture, and ecosystem sectors. As well as within national economic planning processes and fiscal and budgetary policy[48].
AFD	2.79 million	Grant – Technical Cooperation	Grant linked to the 150 million policy-based loan to support the government in the delivery of a set of regulations and analysis, including for the management and monitoring of climate action
AFD	€100 million	Policy-based loan – Tranche II	Policy and regulatory reform in energy, transport, agriculture and ecosystem sectors. As well as within national economic planning processes and fiscal and budgetary policy[44,45].
WB	300 million	Policy-based loan	First Fiscal and Decarbonization Management Development Policy Loan (DPL)[49]
WB	300 million	Policy-based loan	Second Fiscal and Decarbonization Management DPL, in support of Costa Rica's efforts to protect 'people's income and jobs from the impact of COVID-19, strengthen small and medium enterprises (SMEs), reinforce fiscal sustainability, and lay out foundations for a strong post pandemic recovery based on green and low-carbon development[50]
IMF	700 million	Loan, IMF's Resilience and Sustainability Trust (RST)	See[51]
GCF	271 million	Loan 250 million, Grant 21,300	FP166: Light Rail Transit for the Greater Metropolitan Area (GAM). This project aims to install an 85 km double-track, electric light rail transit system in San José's Greater Metropolitan Area which will be powered by more than 98 per cent renewable electricity[52]
Germany	€12,500 million	Grant, IKI	Project "Low-carbon and climate-resilient transformative pathways (Transforma)". To shift production systems from relevant sectors towards low-carbon and climate-resilient pathways, in support of Costa Rica's Nationally Determined Contributions (NDCs) and the implementation of the NDP[52]
GIZ NDC	€10 million	Grant, IKI	Project: ACCION Clima – NDC Implementation and Regional Knowledge Transfer – including in line with the NDP[53]
CABEI/ GIZ	10million	Grant	NAMA Facility Coffee Support Project USD 10 million in support of the decarbonization process of the coffee sector in Costa Rica[54]
UNDP	210,800	Joint Fund	The Joint Collaborative Programme (JCP) to strengthen the social protection system and accelerate SDG achievement through concrete changes in institutional arrangements and local initiatives in three specific cantons, enhancing synergies and coordination between economic, social, and environmental national policies[55]
FAO	210,800	Fund	The Joint Collaborative Programme (JCP) to strengthen the social protection system and accelerate SDG achievement through concrete changes in institutional arrangements and local initiatives in three specific cantons, enhancing synergies and coordination between economic, social, and environmental national policies[55]
ILO	210,800	Fund	
UN WOMEN	210,800	Fund	
UNDP GEF	7,471,945	Grant	Seventh Operational Phase of the GEF Small Grants Programme, aims to strengthen environmental management capacities of country partners at the community level and the engagement of these with national authorities. This will facilitate the introduction of improved management practices, landscape restoration and reforestation efforts, aligned with the country's development plans and decarbonization process[55]
UNDP	250,000	Grant	Forging a common pathway to 2030. To develop material conditions, evidence and data for the strengthening of democratic governance in Costa Rica. This builds upon the NDP and the post-COVID-19 recovery plans, where transitioning to a green economy based on natural capital has become priority[56]
UNDP	350,000	Grant	Project: Rapid Financing Facility. Development of a Green and Inclusive Economy Investor Map to detail investment opportunities for transforming the economy into one more inclusive and greener, as well as the conditions that would allow progress over different priority sectors with an intersectional gender approach[56]
UNDP	4,386,210	Grant + Co financing	Project: International Waters SIXAOLA. To strengthen the transboundary multi-stakeholder integrated water resource management (IWRM) in the Sixaola River Basin shared by Costa Rica and Panama[57]
Total	USD 2.4 billion		

Table 3 (continue) Resources mobilized for LTS design and implementation (in construction)

Robust strategies form **enabling environments,** enable the **use of public funds** and can **mobilise international finance**

Total = ***$2.4bn***

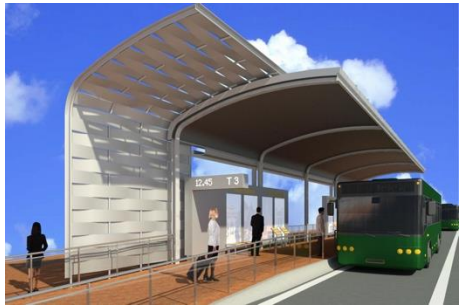
Jaramillo, M., et al. (2023). Data-to-Deal (D2D): Open Data and Modelling of Long Term Strategies to Financial Resource Mobilization - the case of Costa Rica.

Transport decarbonization commitments

Lao PDR's NDC

Unconditional commitments	Conditional commitments	Supporting policies
• Development of **Bus Rapid Transit (BRT)** system in Vientiane complemented by **Non-Motorised Transport (NMT)** infrastructure to improve urban mobility and reduce emissions • Completion of **Lao-China Railway**, providing passenger and freight mobility from Lao PDR to China	• Achieve **30% electrification (on-the-road vehicles)** for passenger cars and two-wheelers by 2030 • Integrate **biofuels** in transport mix such that 10% of transport fuel is from biofuel sources by 2030	• Formulation of the **Clean Renewable Vehicle Development Strategy** (including EV incentives, charging infrastructure and capacity building • 30% reduction in EV annual road tax • Capacity building for government officials and private sector stakeholders on EV technical inspection and registration • Public awareness campaigns

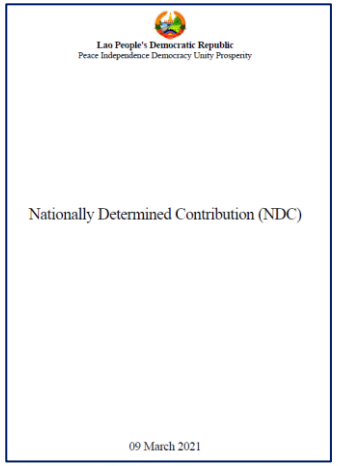
Source: Asia News Network



Source: TPF

Source: Mighty Earth

Source: Laotian Times



Source: Explore-Laos

Lao People's Democratic Republic (2021). Nationally Determined Contribution (NDC).

Green Hydrogen and Ammonia Roadmap
Lao PDR

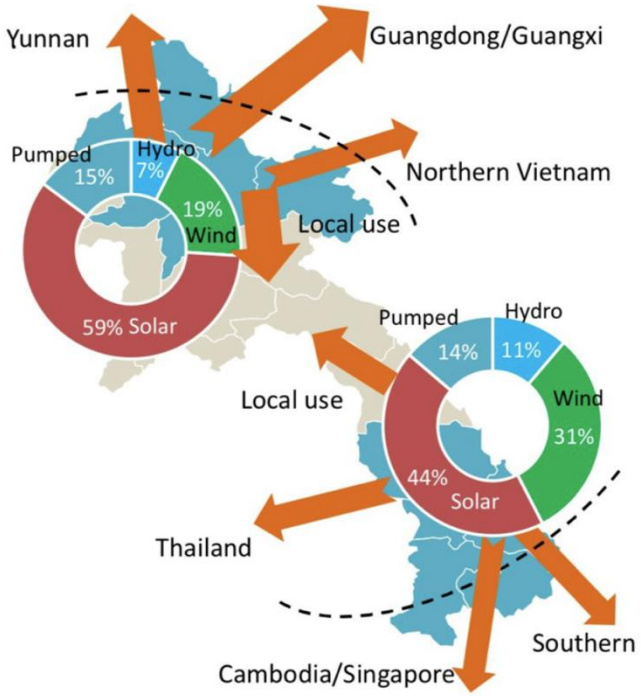
Lao PDR Renewable Electricity Development Plan (2021)

FIGURE 15: Renewable electricity development plan

Hydropower	No	MW
Existing	81	9,615.14
Under-construction	21	1,259.3
CA	18	2,466.2
PDA	109	6,431.95
MOU	245	8,143.43
Total	**474**	**27,916.02**

Solar	No	MW
Existing	8	56
Under-construction	0	0
CA	4	2,688
PDA	13	873
MOU	25	12,147
Total	**50**	**15,672**

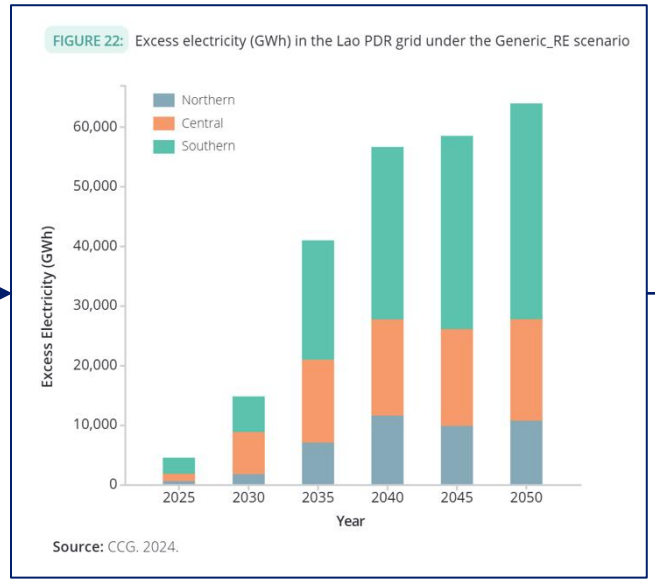
Wind	No	MW
Existing	0	0
Under-construction	0	0
CA	1	600
PDA	1	187.2
MOU	17	13,000
Total	**19**	**13,787**



Source: MEM. 2023.

Content courtesy of Vignesh Sridharan (Imperial College) and Lao PDR National Government

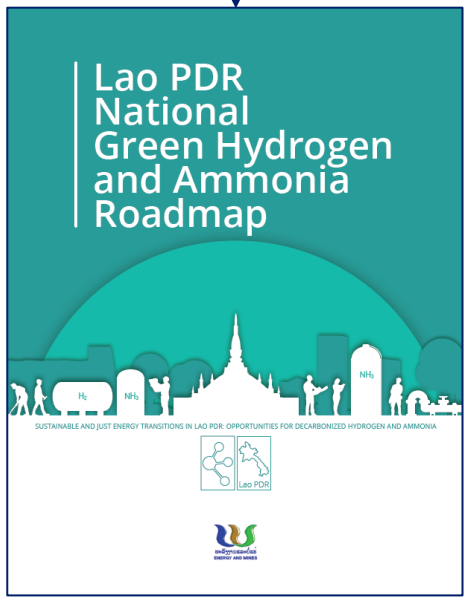
Modelling *excess electricity* in OSeMOSYS → hydrogen potential

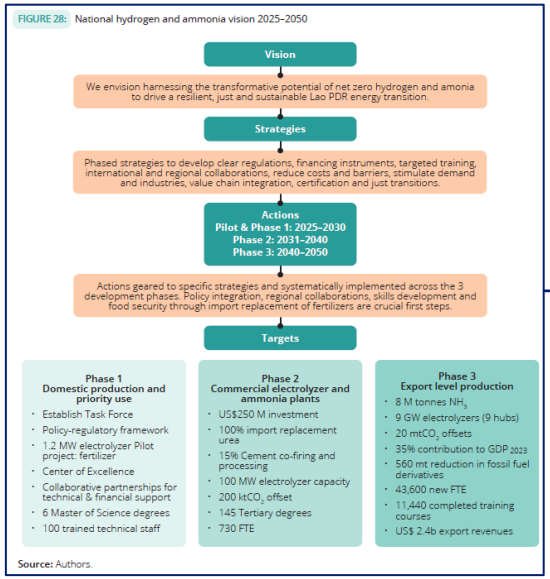


Source: CCG. 2024.

Lao PDR National Green Hydrogen and Ammonia Roadmap (March 2025)

- 3-phase strategy **2025-2050**
- Links and strengthens NDC and LTS





Source: Authors.

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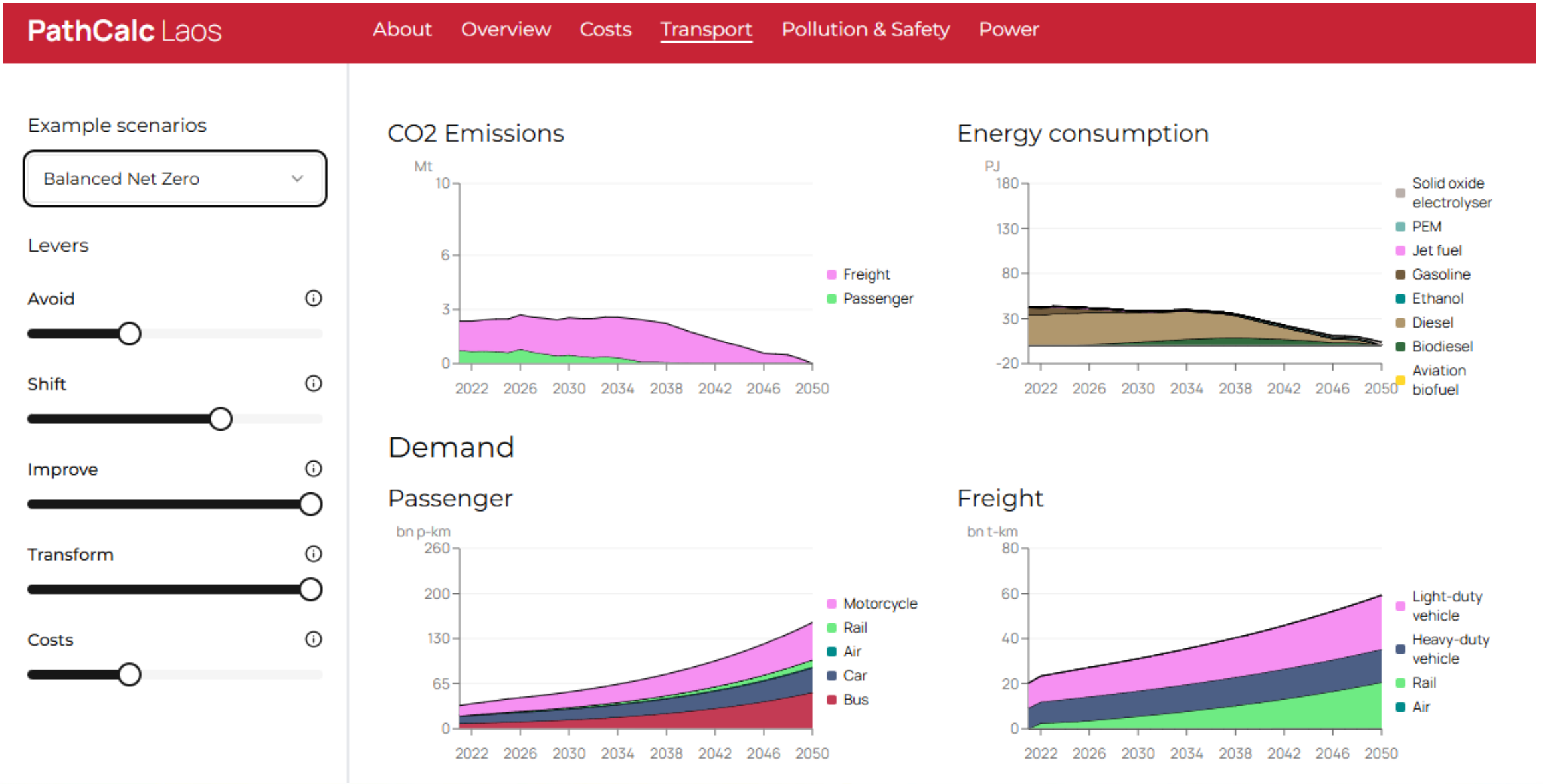
Building pathways
Using ambition levers

- In D2D, we can build scenarios using **ambition levers** to explore trade-offs between action in different sectors
- This can **align NDCs and LTSs** with pathways
- We can use **Pathcalc** to explore these pathways to support policy dialogues
- Let's consider an example – **Pathcalc Laos**

My 2050 pathways builder (levers shown)
https://my2050.energysecurity.gov.uk

PathCalc Laos



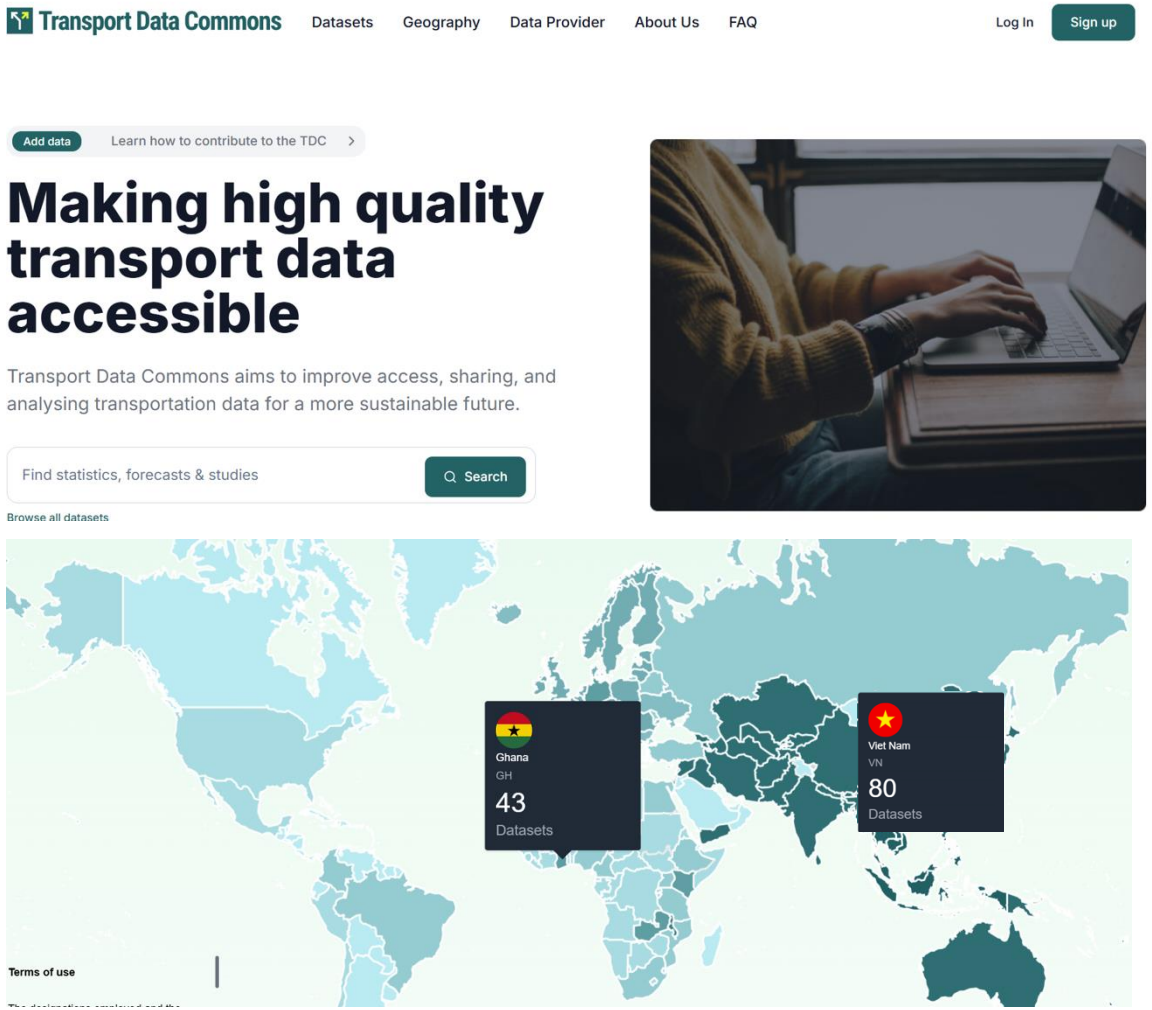
D2D in Transport
COP29 Policy Brief

- How do we apply D2D to the transport sector?
- What specific “system” aspect need considering?
- How can we build decarbonization pathways in a **multi-stakeholder, multi-policy sector?**

Transport Data Commons Initiative (TDCI)

Improving transport data at scale

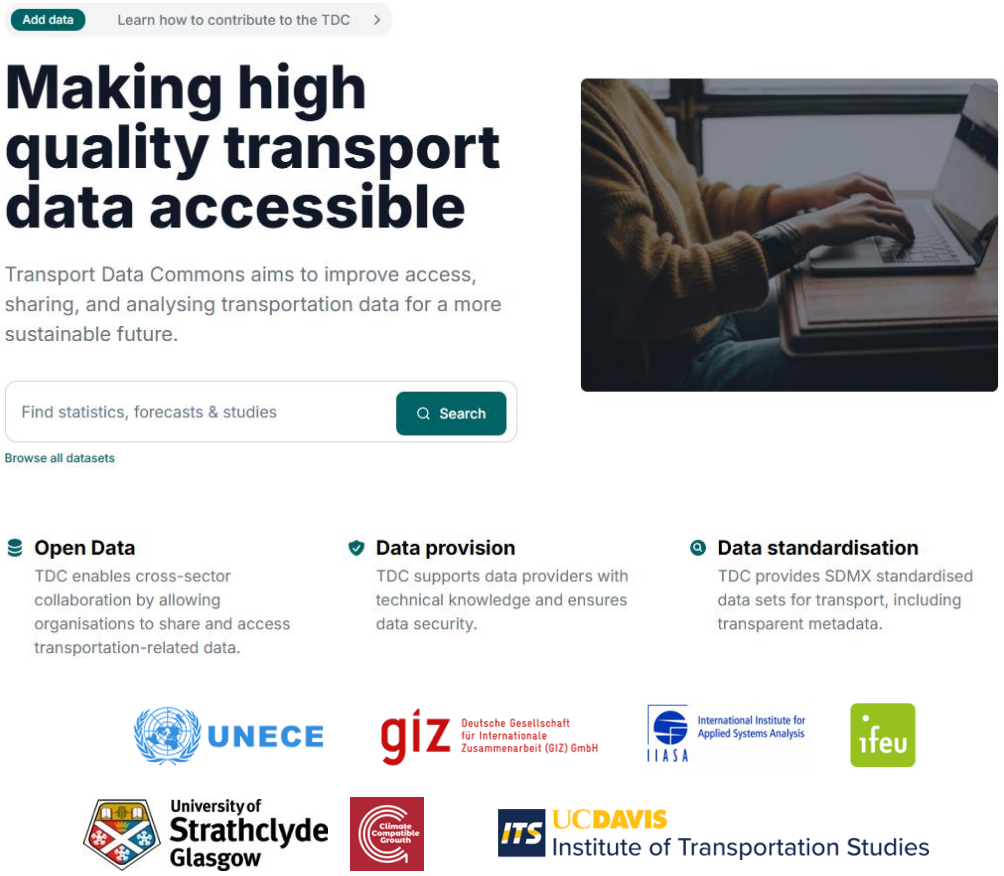
- Mission: become the “**one stop shop**” for global transport data
- Reduce **replication** of data-gathering activities in transport projects
- To enable:
  - **Monitoring** of transport and mobility indicators related to energy and climate
  - **Planning** transport projects, policies and investment pipelines towards meeting SDGs



Transport Data Commons Initiative (TDCI)

Current activities – see transport-data.org

- **Developing TDC tools** for data collection, curation, standardisation and reuse
- **Boosting the number and quality of records**, focussing on 60+ LMIC-based sources
- **Delivering data products and visualisations**, including methodological guides
- **Expanding resources** for data providers and users to engage with TDC
- **Engaging LMIC-based transport data stakeholders** and building requirements for TDC operationalisation



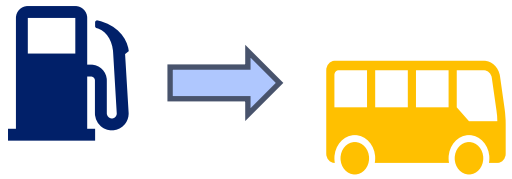
Transport Data Commons Initiative (TDCI)

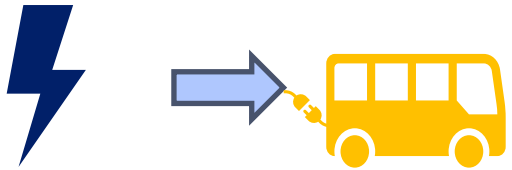
Improving transport data at scale

- TDCI accepted as a **Voluntary Commitment for the UN Decade of Sustainable Transport** (2026–2035)
- Was **showcased at the UN Decade Launch** on 10 December in New York
- **TDC is a recognised global initiative** for tracking sustainable transport
- Creates **strong momentum for improved data sharing and monitoring in the transport sector**

Transport in D2D

Ongoing developments: OSeMobility





- Currently, the transport sector is modelled as part of the **energy system** in D2D
- This is **useful** for considering bulk energy flows between available resources and different mobility services (e.g. buses, trucks, cars, …)
- But there is currently no link to the **spatial aspects of transport and mobility**
- **Watch this space…**

Ongoing research-led developments in D2D

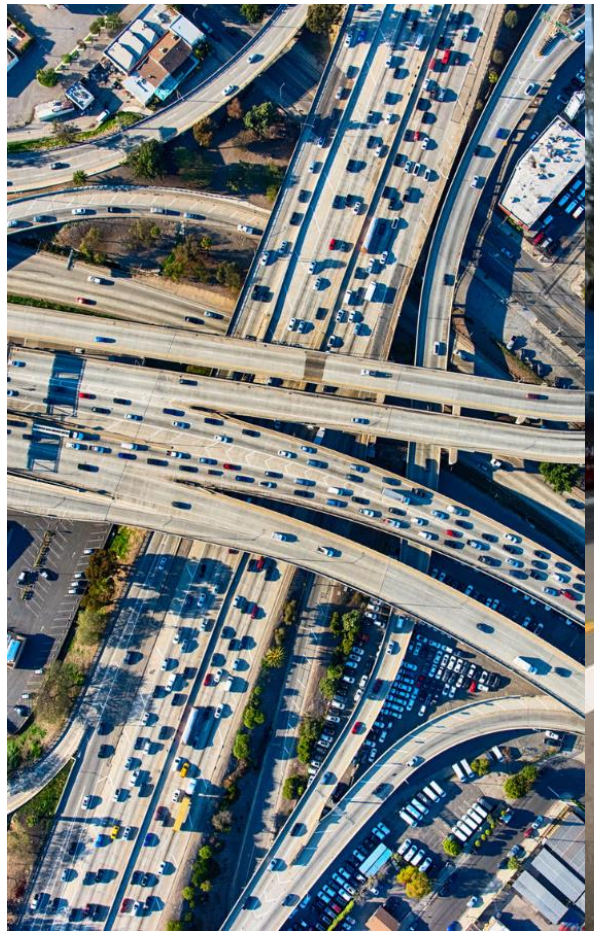
OSeMobility: the open-source mobility model

1. **Modular open-source** structure to allow for different levels of data availability, with **transferability** within global regions

2. **Integrated (soft-linked)** with OSeMOSYS and the rest of the D2D workflow

3. Linked to the **spatial aspects of transport and accessibility**

4. Designed to give **transport stakeholders** a route into D2D

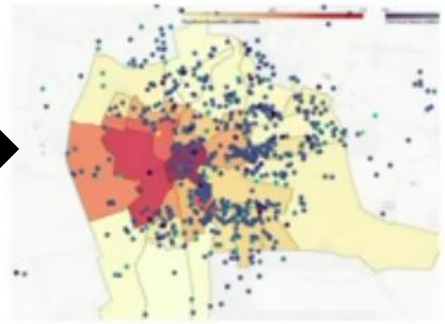


OSeMobility

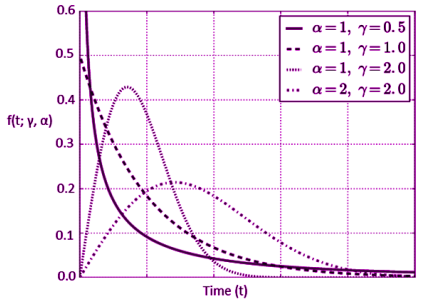
Bringing transport stakeholders into D2D

OpenStreetMap data drives **accessibility model**

Travel demand driven by **accessibility, socio-economics** and **mode-specific factors**



Vehicle stock model meets travel demand, with **import age distribution** a key parameter



→ How much of this can policy/interventions impact?

Scenarios and levers in OSeMobility

Bringing transport stakeholders into D2D

AVOID

Urban planning reform
- Increase the **density**[1] of opportunities in a given area
- Increase the **diversity**[1] of opportunities in a given area

Transport engineering
- Change the **design**[1] of networks (to reduce the physical distance that separates people from opportunities)

SHIFT

Active travel infrastructure
- Increase **walking and cycling infrastructure quantity and quality**

Public transport improvements
- Increase **frequency of buses**
- Increase **density of bus stops**
- **Formalisation** of buses
- Introduce **mass transit** links (e.g. BRT, tramway, metro)
- Introduce **bus lanes**
- **Fare subsidies**

Car demand management
- **Parking pricing**/management
- **Congestion charging**

IMPROVE

Low-emission vehicle subsidy
- **Subsidies/tax breaks** for ultra-low emission vehicles
- **Fossil fuel taxation**

Electric vehicle charging
- Increase **electric vehicle charge point** provision
- **Increase charging power** of public charge points (AC → DC)
- **Battery swap stations** for 2/3 wheelers
- **E-bus charging** depots

[1]Cervero, R., and Kockelman, K. (1997). Travel demand and the 3Ds: Density, diversity, and design. Transportation Research Part D: Transport and Environment, vol. 2. doi: 10.1016/S1361-9209(97)00009-6.

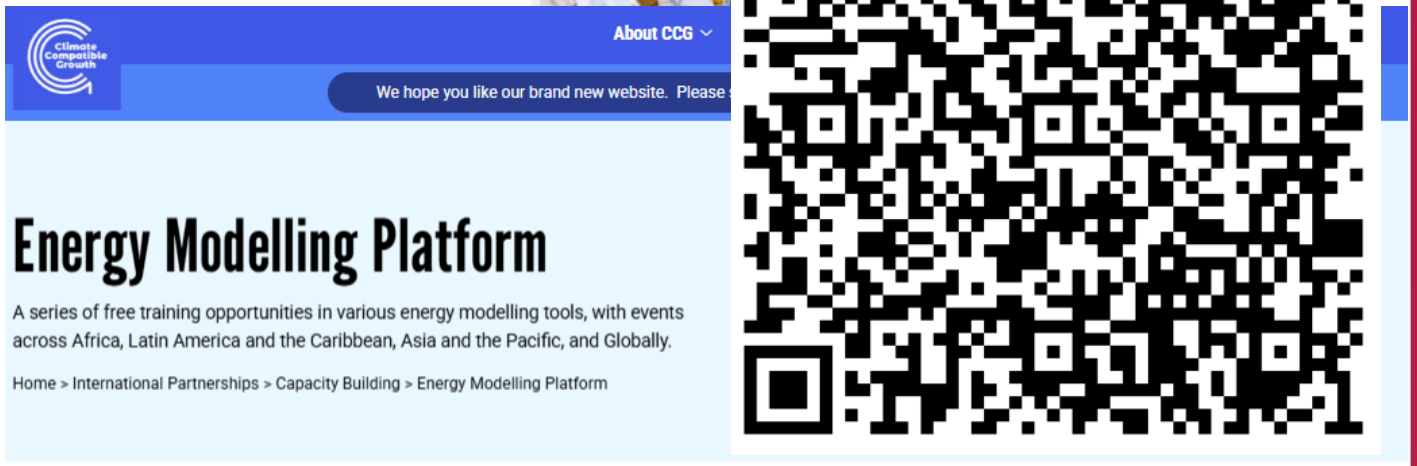
Training opportunities (1)
Transport decarbonization and data-to-deal

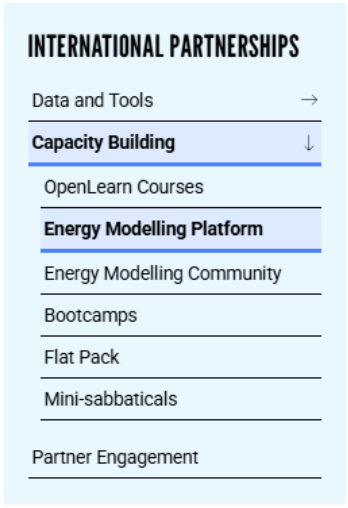
- CCG hosts a **free learning resource** on the Open University (UK)

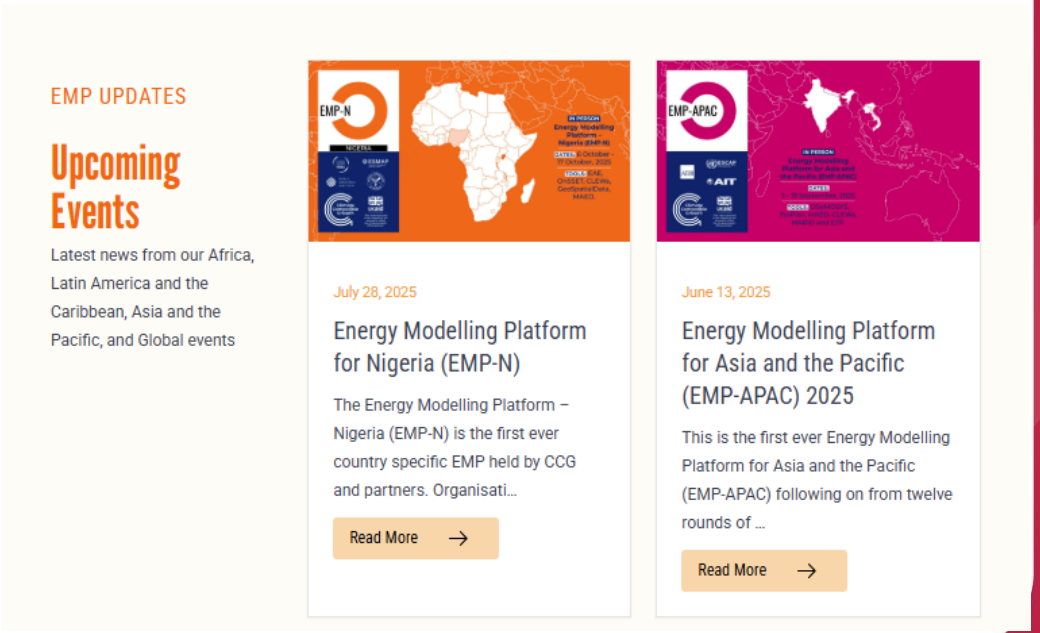
- Newly launched (March 2025) is the "**Transport decarbonization and data to deal**" module, covering:
  - The **transport-energy nexus** and its implications for **decarbonization**.
  - Transport **demand**, clean transport **technologies**, and **equity** considerations.
  - **Transport system modelling in OSeMOSYS**, including **data preparation** and **scenario development**.
  - The role of **uncertainty** and **robust decision-making** in transport pathways.
  - **Financing mechanisms for transport transitions** and how D2D tools can support **investment decisions**.

Training opportunities (2)
Energy Modelling Platform (EMP)

- EMP is a **collaborative, open-source initiative** designed to support energy system modelling and planning, particularly in developing countries
- Run by CCG, UNDESA and the IEA
- Four EMPs every year (Africa, Asia, Europe, Global)







Q&A

Thanks for the invite to present; thanks for listening

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UCL