



TECHNICAL SESSION 4 · DAY 2

Overview of Software & Tools for Developing Renewable Energy Tariff Models

SAM & PySAM · CREST · RETScreen Expert — strengths, limits and fit for regulators and lenders

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Energy Policy · Tariff · Private Investment · Climate Finance & Carbon Markets

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SAARC Training Workshop on Financial Modeling for
Renewable Energy Projects

*Map for illustration only; not an authoritative depiction
of boundaries.*



SESSION 4 · LEARNING OBJECTIVES

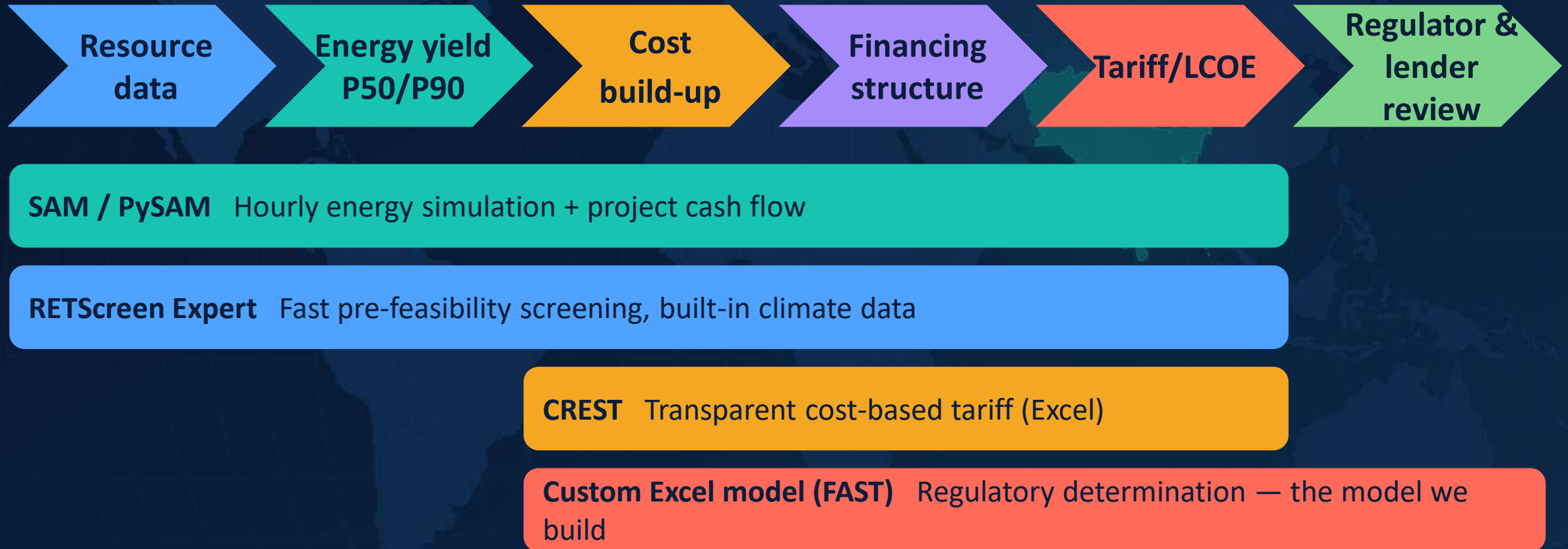
What you will be able to do after this session

- 1 Place free tools — SAM, PySAM, CREST, RETScreen — in the tariff-determination workflow
- 2 Use free resource-data tools to test developer energy-yield claims
- 3 Know which specialised tools exist for hybrids, bioenergy and green hydrogen
- 4 Judge each tool's fit for regulatory determination versus lender due diligence
- 5 Download, install and run a first SAM case
- 6 Keep the determination model transparent, with tools as independent cross-checks



BIG PICTURE

Where each tool fits in the tariff workflow



No single free tool covers the whole chain — regulators combine a yield tool with a transparent tariff model.



TOOL 1

System Advisor Model (SAM) — the free techno-economic workhorse



Developer: National Laboratory of the Rockies (NLR, formerly NREL), US DOE

Cost: free; open-source code on GitHub

Latest: SAM 2026.7.3 (Windows, macOS, Linux) — sam.nlr.gov/download.html

Strengths

- Hourly models for PV, wind, CSP, geothermal, biomass, solar water heating, fuel cells, marine, batteries
- Detailed financial models: single-owner PPA, partnership flip, merchant, LCOE calculator
- Built-in P50/P90 analysis and parametric sweeps

Limitations

- No dedicated small-hydro performance model
- Default tax & incentive logic is US-centric — must be re-set
- Cost-plus regulated tariff structures need workarounds

Best used for

- Independent check of developer yield claims
- Building P50/P90 profiles for the tariff model
- Comparing technologies and configurations



TOOL 1B

PySAM — SAM's engine, scriptable in Python

```
# pip install nrel-pysam
import PySAM.Pvwattsv8 as pv

m = pv.default("PVWattsSingleOwner")
m.SolarResource.solar_resource_file =
"site_tmy.csv"
m.SystemDesign.system_capacity = 50000    # kW
m.execute()

print(m.Outputs.annual_energy / 1e6, 'GWh')
```



Batch runs

Hundreds of sites or configurations in minutes



Sensitivity sweeps

Loop over capex, CUF, rates — feed the Excel model



Reproducible

Scripts document every assumption for auditors

Source: PySAM (PyPI: nrel-pysam). Code illustrative



TOOL 2

CREST — the regulator's cost-based tariff spreadsheet



Cost of Renewable Energy Spreadsheet Tool

Free Excel models from NLR (prepared by Sustainable Energy Advantage) · five technology versions incl. solar, wind, geothermal and anaerobic digestion · User Manual v4 (2013)

What it does

- Year-one and levelised cost of energy
- Designed to set cost-based incentive rates (feed-in tariffs)
- Shows how each economic driver moves the cost of energy

Limitations

- You supply the energy yield — no hourly simulation
- US tax, depreciation & incentive defaults must be replaced
- Older release; check formulas before use

Best used for

- Teaching cost-based tariff logic
- Cross-checking a regulator's own model
- Quick 'what-if' on financing terms

Source: NLR, CREST: Cost of Renewable Energy Spreadsheet Tool (nrel.gov/analysis/crest).



TOOL 3

RETScreen Expert — fast screening with a global database



Developer: Natural Resources Canada (CanmetENERGY Varennes)

Access: Viewer mode free · Professional mode by annual subscription (save, print, premium features)

Platform: Windows, .NET Framework 4.8+

Strengths

- Covers solar, wind, hydro (incl. small hydro), bioenergy, efficiency
- Climate data from ~6,700 ground stations plus NASA satellite data
- Benchmark, cost, product and hydrology databases; many languages

Limitations

- Viewer mode cannot save or print
- Simplified financial structure — not a regulatory tariff model
- Less transparent calculations than a spreadsheet

Best used for

- Pre-feasibility screening of many sites
- Small-hydro first-cut energy estimates
- Training and quick benchmarking

Source: Natural Resources Canada, RETScreen (natural-resources.canada.ca); OpenEI; energypedia.



TOOLS · RESOURCE DATA

Free resource-data tools: start with a good energy estimate



Global Solar Atlas

World Bank / ESMAP

Irradiation (GHI, DNI) and indicative PV output for any site; GIS layers downloadable

► globalsolaratlas.info



Global Wind Atlas

World Bank / ESMAP & DTU

Mean wind speed and power density at several hub heights; wind roses

► globalwindatlas.info



PVGIS

European Commission JRC

Hourly solar radiation and PV yield; exports TMY files usable in SAM

► re.jrc.ec.europa.eu/pvg_tools



NASA POWER

NASA

Long-term daily/hourly solar, temperature and wind data worldwide

► power.larc.nasa.gov

Screening data only — bankable projects still need on-site measurement and an independent yield report.



TOOLS · BEYOND THE CORE THREE

Specialised tools for yield, hybrids, bioenergy and hydrogen

Tool	Developer	Access	Best for
SAM: biomass, geothermal, CSP, SWH	NLR	Free	Dispatchable RE performance + cost
H2A / H2A-Lite	NLR (US DOE)	Free Excel (Lite: register)	Cost of hydrogen production
H2FAST	NLR	Free web tool & Excel	Financing of hydrogen projects
HOMER Pro	UL Solutions	Commercial (trial)	Hybrid / mini-grid sizing
PVsyst	PVsyst SA	Commercial	Bankable PV yield (P50/P90)
WAsP / windPRO	DTU / EMD	Commercial	Wind layout, wakes, bankable yield
Workshop H2_LCOH sheet	This training	Free (Excel)	LCOH linked to your RE tariff

Source: NLR H2A / H2A-Lite / H2FAST pages (2025–26); sam.nlr.gov; vendor websites. Commercial tools named for information only.



COMPARISON

Side-by-side: which tool for which job?

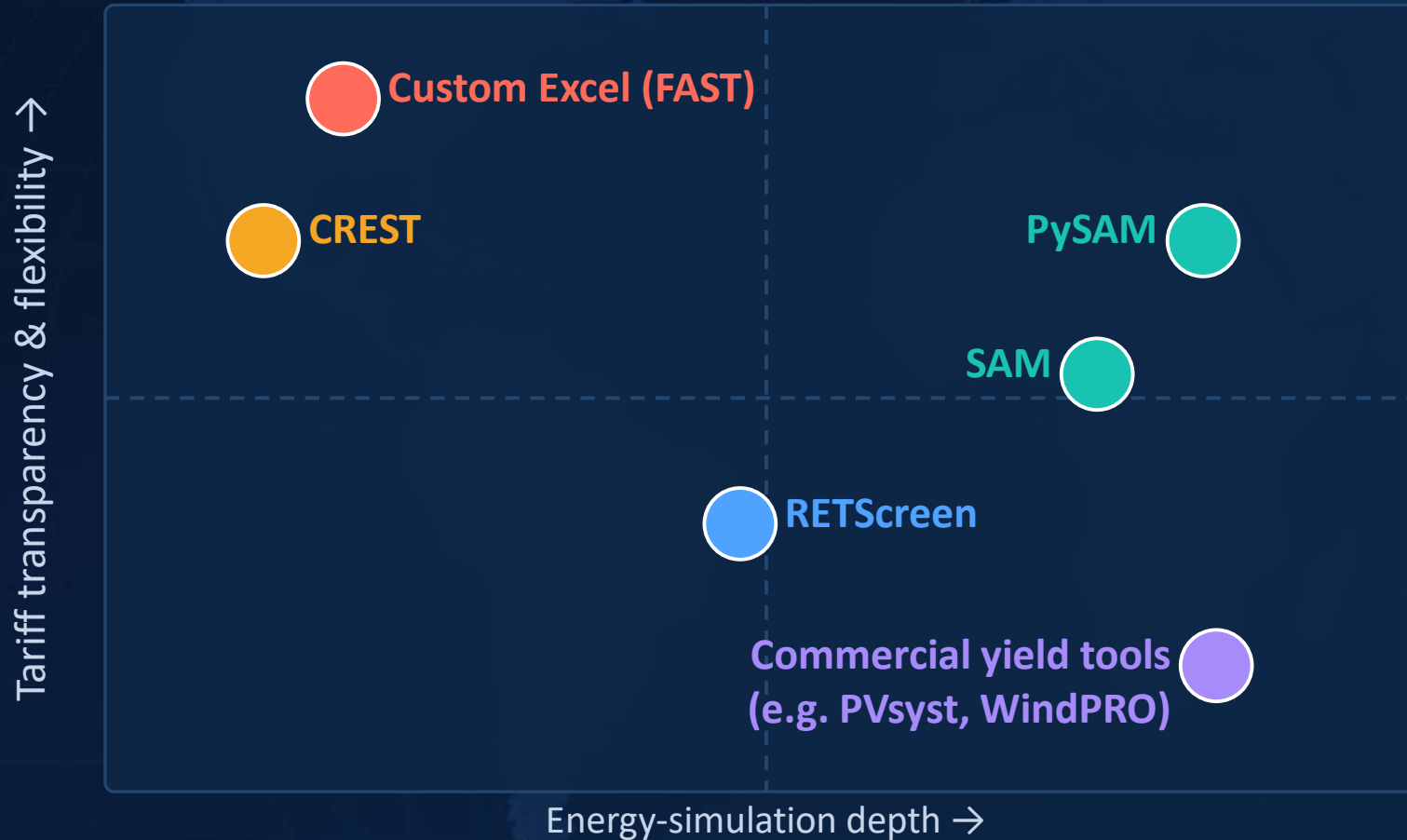
Criterion	SAM	PySAM	CREST	RETScreen (Viewer)	Custom Excel (FAST)
Free to use	●	●	●	◐	●
Covers small hydro	○	○	◐	●	●
Energy-simulation depth	●	●	○	◐	◐
Financial-structure flexibility	◐	●	◐	◐	●
Transparency for the regulator	◐	◐	●	◐	●
Fit for lender due diligence	◐	◐	◐	◐	◐
Low data / skill burden	◐	○	◐	◐	◐
Covers bioenergy & geothermal	●	●	◐	●	●
Covers green hydrogen	○	○	○	○	◐

● strong ◐ good ◐ moderate ◐ limited ○ not available — facilitator assessment for discussion



SUITABILITY

Positioning: technical depth vs tariff transparency



Regulators

need the top-left: every formula visible, every input defensible.

Lenders

need the right side: a bankable P50/P90 yield — then audit the cash-flow model.



DATA REQUIREMENTS

What each tool needs from you

Input	SAM / PySAM	CREST	RETScreen	Custom Excel
Hourly weather / resource file (TMY)	✓	—	built-in	—
Annual energy or capacity factor	output	✓	output	✓
Equipment specifications	✓	—	✓	—
Capex & O&M breakdown	✓	✓	✓	✓
Debt terms (rate, tenor, grace, frequency)	✓	✓	✓	✓
Tax, depreciation, indexation rules	✓	✓	✓	✓
Tariff structure (EPP / CPP, indexation)	partial	partial	—	✓

Tip: collect one 'project data pack' and feed the same numbers into every tool — differences then reveal method, not data.



RECOMMENDATION

A practical toolchain for SAARC regulators and lenders



Steps 3–5 are exactly what you will build in Working Exercises I–III.



HANDS-ON · INSTALLATION

Download SAM now — free for Windows, macOS and Linux

► <https://sam.nlr.gov/download.html>

- 1 **Open the download page** Current version: SAM 2026.7.3
- 2 **Choose your system** Windows 10/11 64-bit (.exe, ~78 MB) · macOS 12+ (.pkg) · Linux (.run)
- 3 **Install** Windows default folder: C:/SAM/2026.7.3 — versions install side by side
- 4 **Register on first run** Enter your e-mail to receive a free software key
- 5 **Learn** Help: [natlabrockies.github.io/SAM](https://github.com/natlabrockies/SAM) · videos & webinars on sam.nlr.gov

Other downloads

PySAM: `pip install nrel-pysam`

CREST: nrel.gov/analysis/crest

RETScreen: natural-resources.canada.ca

H2A-Lite: nlr.gov/hydrogen/h2a-lite

Source: sam.nlr.gov/download.html (accessed Sep 2026).



HANDS-ON · DEMO

Live demo — a 50 MW solar project in SAM in five minutes

SAM download

sam.nlr.gov/download.html

PySAM

sam.nlr.gov → SDK / PySAM

Solar data (TMY)

[PVGIS · Global Solar Atlas](#)

Workshop model

SEC_RE_Tariff_Model (Excel)

Live demo — 50 MW solar in SAM

- 1 New project ▶ Photovoltaic ▶ PVWatts ▶ Single owner
- 2 Location: load a weather file for your site
- 3 System design: 50,000 kW AC, tracker on/off
- 4 Costs: enter USD/kW from your Inputs sheet
- 5 Financial parameters: debt %, rate, tenor
- 6 Simulate ▶ compare LCOE and P90 with your model



SESSION 4

Key takeaways



Free tools are powerful, but none replaces a transparent, auditable tariff model for regulatory determination.



Use SAM / PySAM or RETScreen to test energy-yield claims; feed P50/P90 into the tariff model.



Use CREST to cross-check cost-based tariff logic — after stripping US tax defaults.



One data pack, many tools: consistent inputs make differences meaningful.

POLL ► Which tool will your regulator or utility try first? Tell us before the break!