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On Financing of Rooftop Solar Projects in Tajikistan

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Study objectives

- Perform energy modelling and simulations of rooftop solar (RTS) systems in Tajikistan using:
  - > Actual data on: solar insolation, available roof areas, electricity consumption for each building type (business, social, residential), Capex, O&M costs
  - > Hypothetical data about: possible metering schemes and end-user tariff levels
- Identify optimal, superior-to-grid RTS options
- Analyse financially viable RTS options and financially feasible tariff levels
- Assess Tajikistan's readiness for implementing RTS financing schemes

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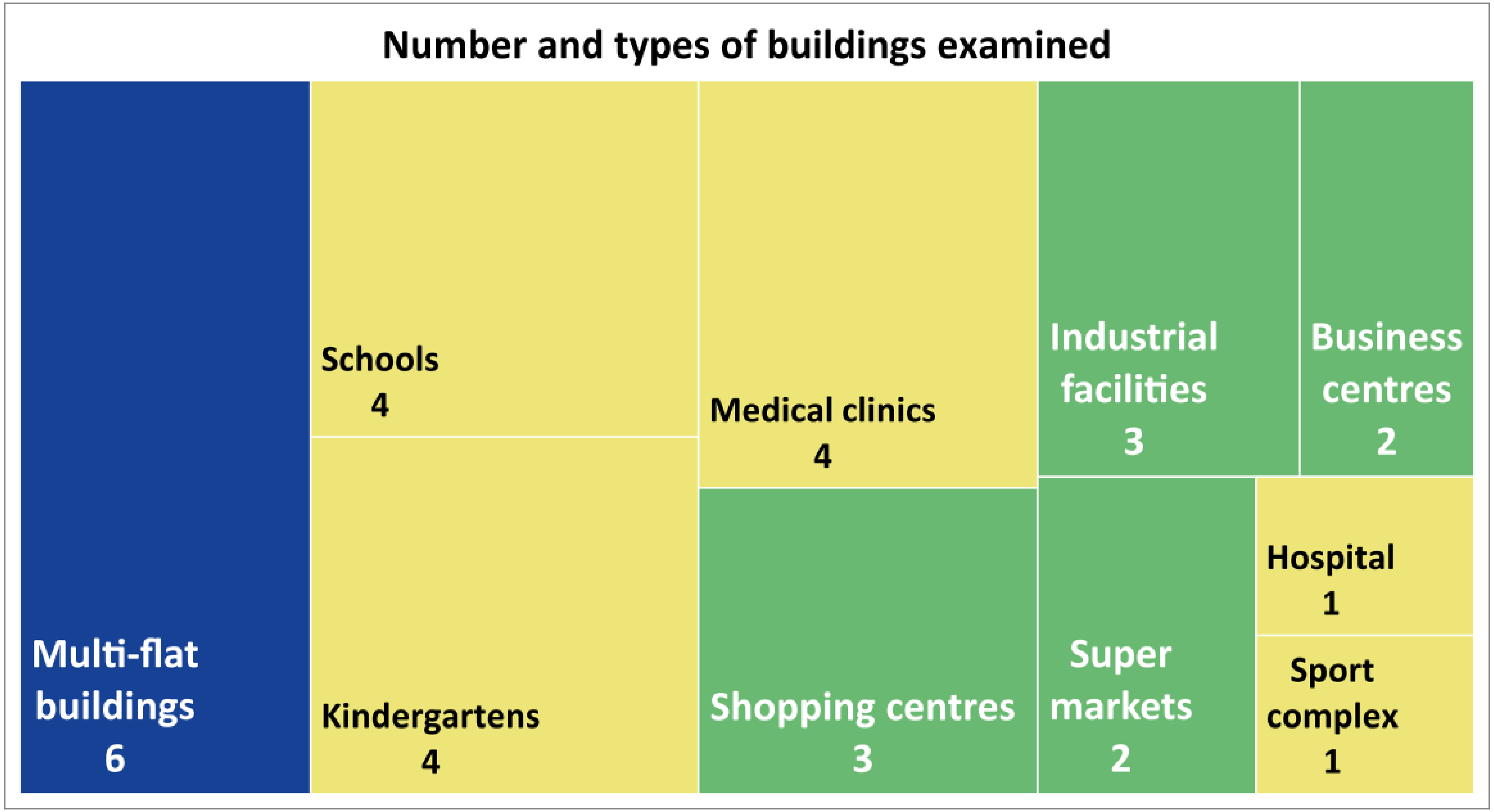
Buildings examined - actual electricity consumption data

Segment key and no. of buildings:

Residential segment	10
Social segment	14
Business segment	6
Total buildings examined	30



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Parameters of buildings used for HomerPro simulations

Name	Segment and usage	Address	Total roof area	Useful roof area (80% of total area)	Max available PV system*	Daily power use	Annual power use
			m2	m2	kW	kWh/day	kWh/year
Dushanbe Mall	Business, shopping centre	Bekhzod Street 47, Dushanbe	8,650	6,920	690	10,960	4,000,465
International Presidential School	Social, school	Karamov Street 101, Dushanbe	12,820	10,250	1,250	1,517	553,747
Residential-1	Residential, living	Nusratullo Makhsum Avenue 61/1, Dushanbe	413	290	21	20	7,424

Note: * - applying max of 1kW PV installed capacity for 5-15m2 of useful roof area

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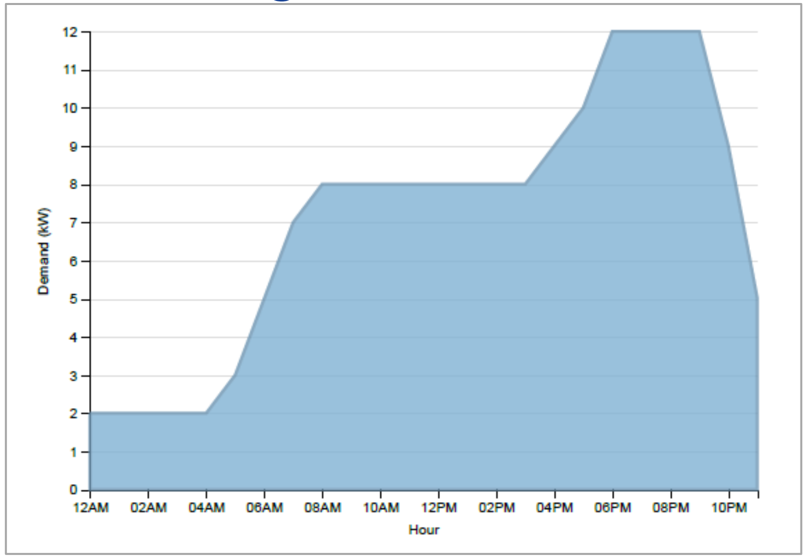
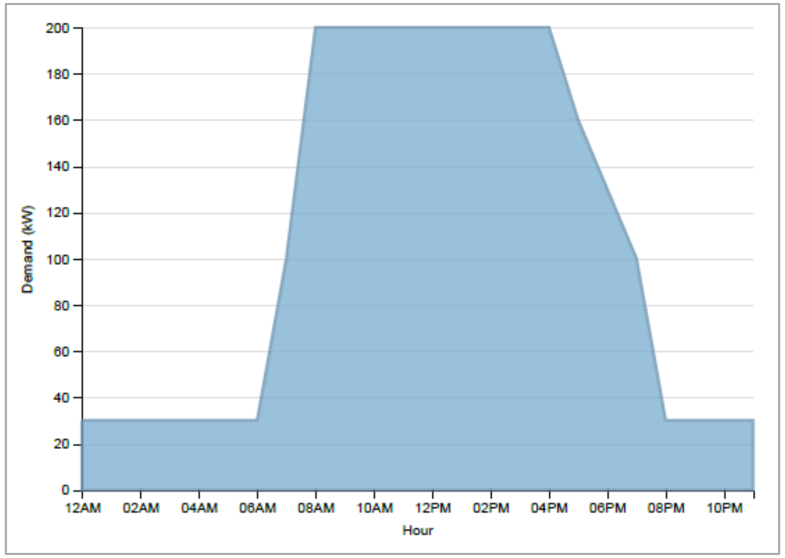
Different hourly load electricity profiles

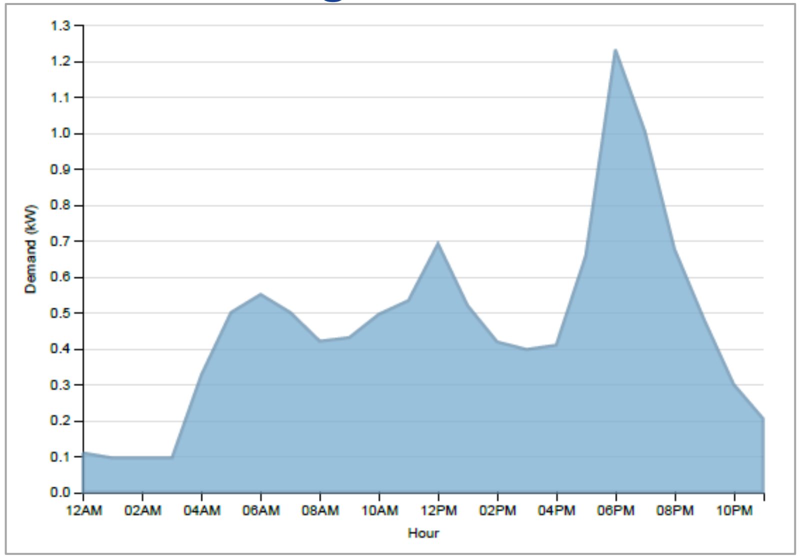
Business segment



Social segment



Residential segment



Practical consumer needs satisfied by modelled and selected RTS systems:

- Business and social segments – all consumer electricity needs
- Residential segment - power required for lighting of general premises and elevators

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Financial and operational assumptions

Investment and operational cost assumptions

RTS system component	Lifetime	O&M	Initial investment	
		USD/year	Amount	Unit of measurement
Project lifetime	25 years			
PV system	25 years	4	418	USD/kW
Storage system: Li-Ion	15 years	1	262	USD/kWh
Storage system: Lead Acid	7 years	1	150	USD/kWh
On-grid convertor	15 years	0.5	38.5	USD/kW
Hybrid convertor	15 years	0.5	180-270	USD/kW
Generator (diesel)	15,000 hours	300	300	USD
Diesel fuel price		1 (USD/litre)		

Financial and economic assumptions

Assumption	Description / amount
Value added tax (VAT)	VAT excluded from calculations
Inflation	Modelling made in real terms, values not adjusted for inflation
Discount rate used	10%

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Principles of rooftop solar modelling with HomerPro

- Large number of iterative HomerPro software runs
- Rooftop solar (RTS) option is compared to base-case
- Base-case = the use of the grid option
- We structured RTS modelling and simulations to include and combine:
  - > 3 remuneration schemes and
  - > 3 different tariff rate levels

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Rooftop solar remuneration schemes applied

- Without net metering
  > consumer is not paid for the surplus PV energy produced and sent to the grid
- Net metering (NEM)
  > rate paid for unconsumed PV energy exported to the grid is equal to the retail end-user electricity tariff (i.e. the import rate is equal to the export rate)
- Net billing
  > export to the grid rate significantly differs from (and usually is considerably lower than) the import rate

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Tariff rate levels analysed

- Current tariffs
  > tariffs effective in year 2024 for the specific consumer category (business, social or residential)
- Average tariffs
  > weighted-average end-user tariff of 0.032 USD/kWh for year 2024, which is the estimated average rate of the whole power market of Tajikistan
- Switching values
  > tariff levels at which the RTS system starts to be optimal (superior) compared to the current grid option, it signals the break-even tariff level for viable RTS deployment

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RTS system options modelled

Business segment

Option No.	Remuneration scheme	Tariff level	Import from the grid rate	Export to the grid rate	Optimal system
			USD/ kWh	USD/ kWh	
1	**Without net metering**	**Current**	**0.064**	**0**	**RTS**
2	Without net metering	Average	0.032	0	Grid
3	**Without net metering**	**Switching value**	**0.039**	**0**	**RTS**
4	**Net metering**	**Current**	**0.064**	**0.064**	**RTS**
5	Net metering	Average	0.032	0.032	Grid
6	**Net metering**	**Switching value**	**0.039**	**0.039**	**RTS**
7	**Net billing**	**Switching value**	**0.064**	**0.032**	**RTS**

Social segment

Option No.	Remuneration scheme	Tariff level	Import from the grid rate	Export to the grid rate	Optimal system
			USD/ kWh	USD/ kWh	
8	Without net metering	Current	0.028	0	Grid
9	Without net metering	Average	0.032	0	Grid
10	**Without net metering**	**Switching value**	**0.040**	**0**	**RTS**
11	Net metering	Current	0.028	0.028	Grid
12	Net metering	Average	0.032	0.032	Grid
13	**Net metering**	**Switching value**	**0.039**	**0.039**	**RTS**
14	Net billing	Switching value	0.028	0.043	RTS (nm*)

Residential segment

Option No.	Remuneration scheme	Tariff level	Import from the grid rate	Export to the grid rate	Optimal system
			USD/ kWh	USD/ kWh	
15	Without net metering	Current	0.024	0	Grid
16	Without net metering	Average	0.032	0	Grid
17	**Without net metering**	**Switching value**	**0.057**	**0**	**RTS**
18	Net metering	Current	0.024	0.024	Grid
19	Net metering	Average	0.032	0.032	Grid
20	**Net metering**	**Switching value**	**0.039**	**0.039**	**RTS**
21	Net billing	Switching value	0.024	0.043	RTS (nm*)

Note: nm* - not meaningful in practice

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RTS modelling and simulation results

Out of 21 option simulated, under 9 options RTS is more viable than the grid

All 5 business segment options viable within current tariff rate of 0.064 USD/kWh

- 2 options financially feasible even without net metering
- 3 options feasible with net metering & net billing

4 options of social and residential segment viable, but outside of current tariff range

- Logical, due to end-user tariff subsidisation in these segments
- In 3 out of 4 options, the rate gap of about 20% is manageable

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Optimal RTS systems identified

Key operational and economic parameters of optimal RTS systems

Option No.	Segment	PV capacity	Production	PV share of production	Consumption	Grid sales	CO2 savings
		kW	kWh/year	%	kWh/year	%	kg/year
1	Business	690	4,056,035	25.6	4,000,465	0.5	607,398
3	Business	690	4,058,402	25.6	3,999,121	0.5	605,901
4	Business	690	4,056,035	25.6	4,000,465	0.5	607,398
6	Business	690	4,056,035	25.6	4,000,465	0.5	607,398
7	Business	690	4,056,035	25.6	4,000,465	0.5	607,398
10	Social	150	566,791	39.9	553,747	1.1	130,568
13	Social	1,250	2,021,723	93.1	1,920,364	71.5	257,420
17	Residential	1.51	7,553	30.1	7,424	1.67	1,276
20	Residential	21	35,179	89.9	33,478	78.2	2,358

Option No.	Segment	Remuneration scheme	Tariff level	Initial Capex	Import- export rates	LCOE	IRR	Simple payback
				USD	USD/kWh	USD/kWh	%	Years
1	Business	Without net metering	Current	307,882	0.064-0.000	0.0576	18.6	5.26
3	Business	Without net metering	Switching value	307,071	0.039-0.000	0.0388	10.1	8.93
4	Business	Net metering	Current	307,882	0.064-0.064	0.0573	19.1	5.14
6	Business	Net metering	Switching value	307,882	0.039-0.039	0.0385	10.4	8.72
7	Business	Net billing	Switching value	307,882	0.064-0.032	0.0573	19.1	5.14
10	Social	Without net metering	Switching value	66,728	0.040-0.000	0.0392	10.3	8.77
13	Social	Net metering	Switching value	557,564	0.039-0.039	0.0102	10.4	8.72
17	Residential	Without net metering	Switching value	672	0.057-0.000	0.0515	15.6	6.19
20	Residential	Net metering	Switching value	9,368	0.039-0.039	0.00763	10.4	8.72

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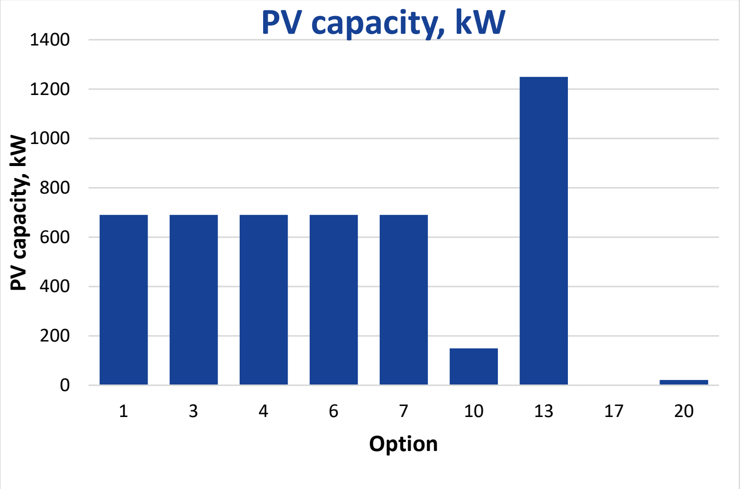
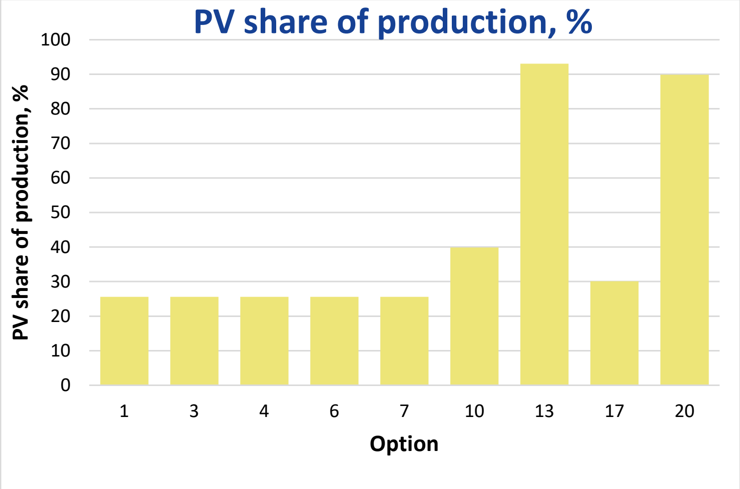
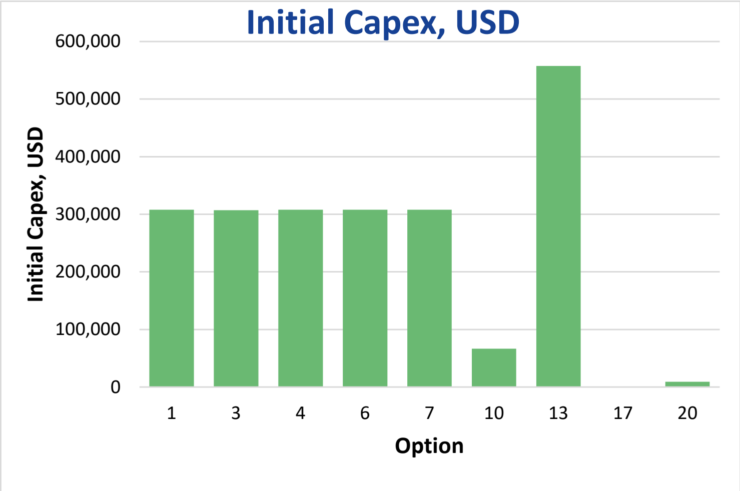
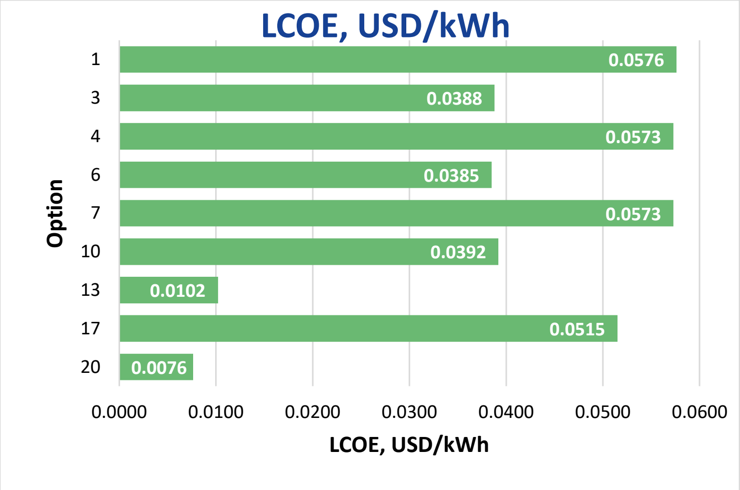
Optimal RTS systems are very different

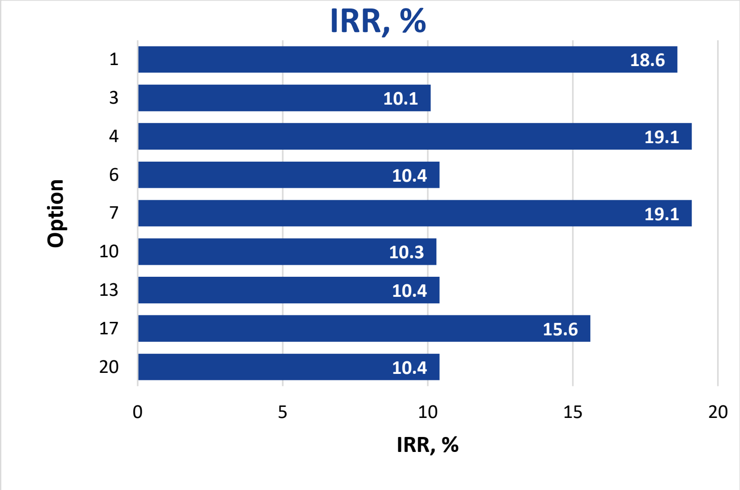
Key operational and economic parameters of optimal RTS systems

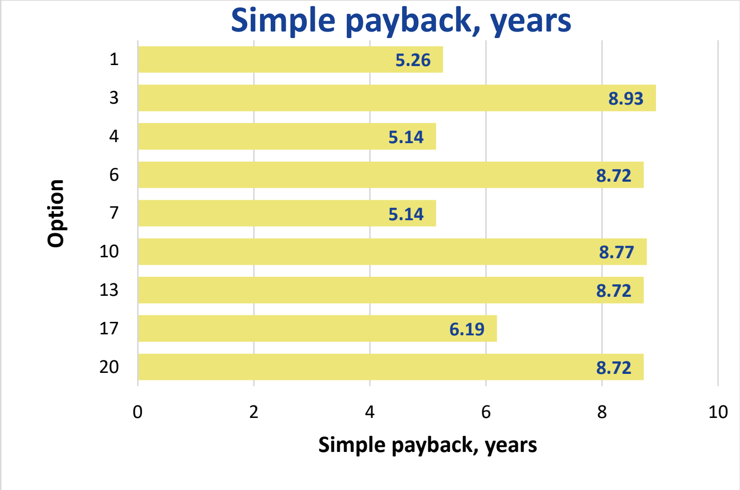












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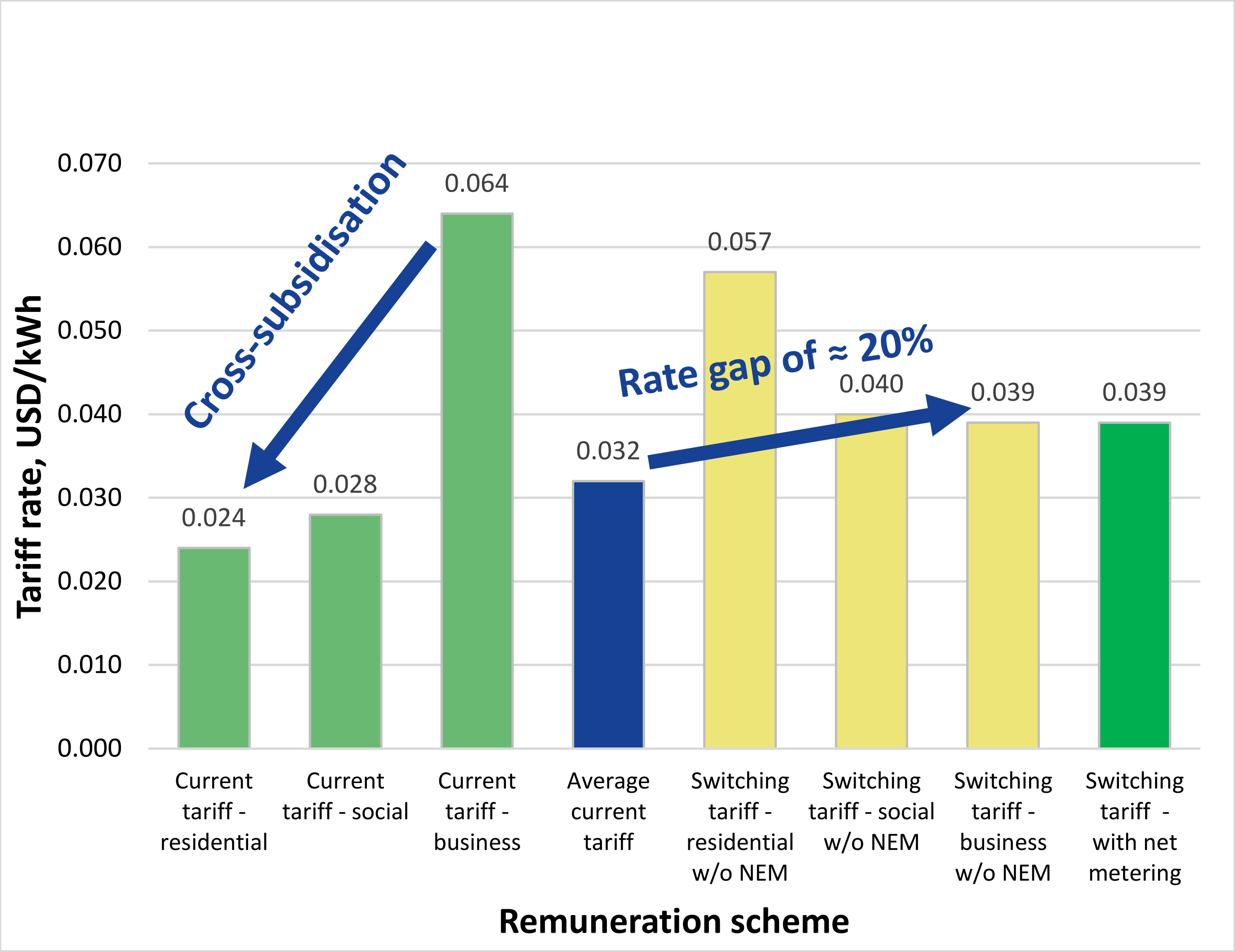
Comparison of switching and current tariff rates



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Conclusions on RTS financial feasibility

- Despite below cost-recovery level of average tariffs in Tajikistan, there are certain segments already, where RTS system deployment is financially feasible
- Business segment end-users have the most of identified financially feasible RTS options due to the highest tariff rate charged to this consumer category
- Current tariff level in social and residential segments is insufficient for financially feasible adoption of RTS. However, the rate gap of around 20% is manageable and could be absorbed in relatively short term
- To facilitate the development of distributed PV (DPV) market, and before designing detailed RTS financing schemes, Tajikistan should adopt a comprehensive package of DPV/RTS oriented policies and regulatory measures.

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Thank you for your attention!

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