

**University of Stavanger**  
**Faculty of Science and Technology**  
**Department of Safety, Economic and Planning (ISØP)**

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**Building integrated solar energy in compact cities - shadow and reflection issues related to densification of cities.**

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**Hassan Gholami**  
**PhD Student**

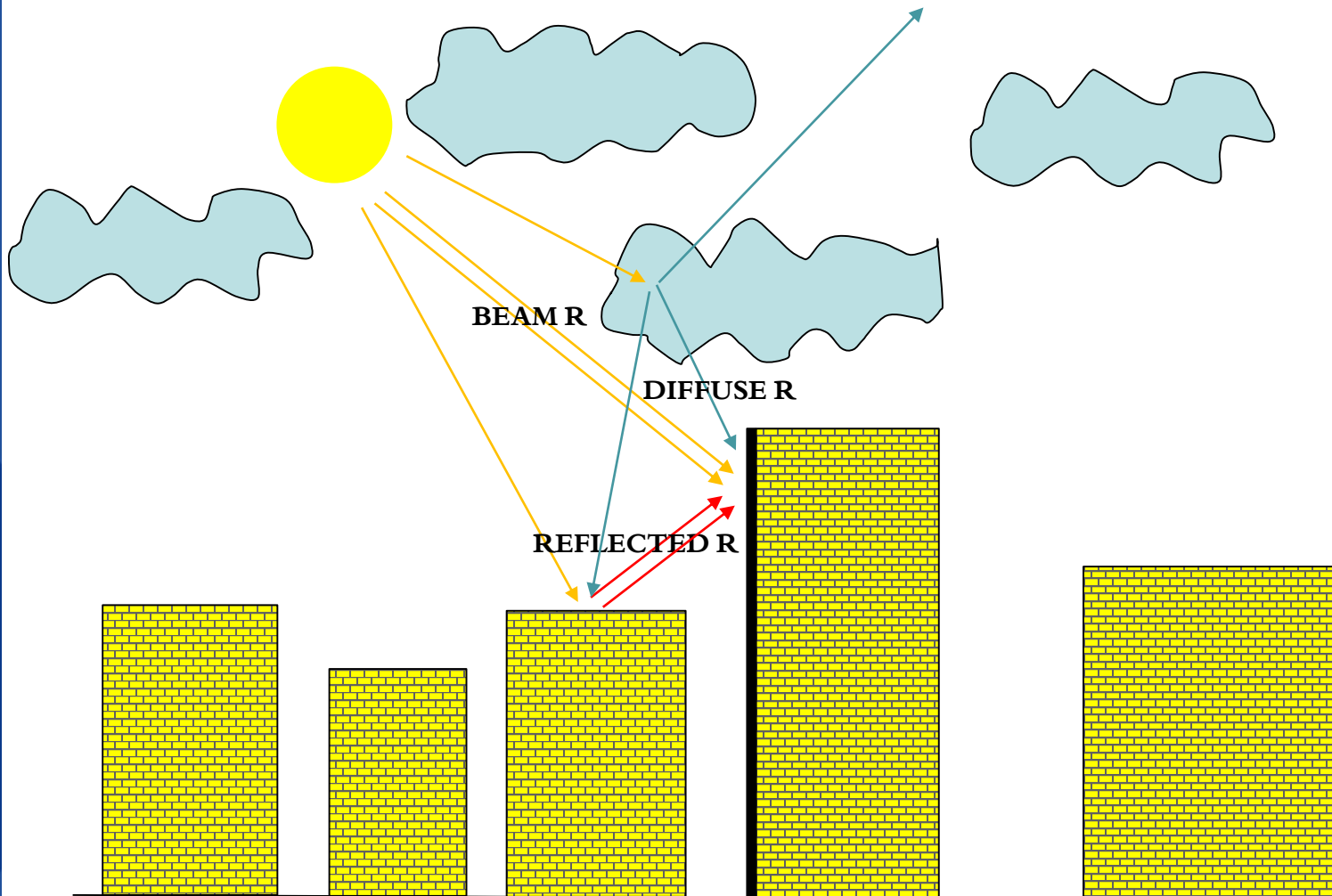


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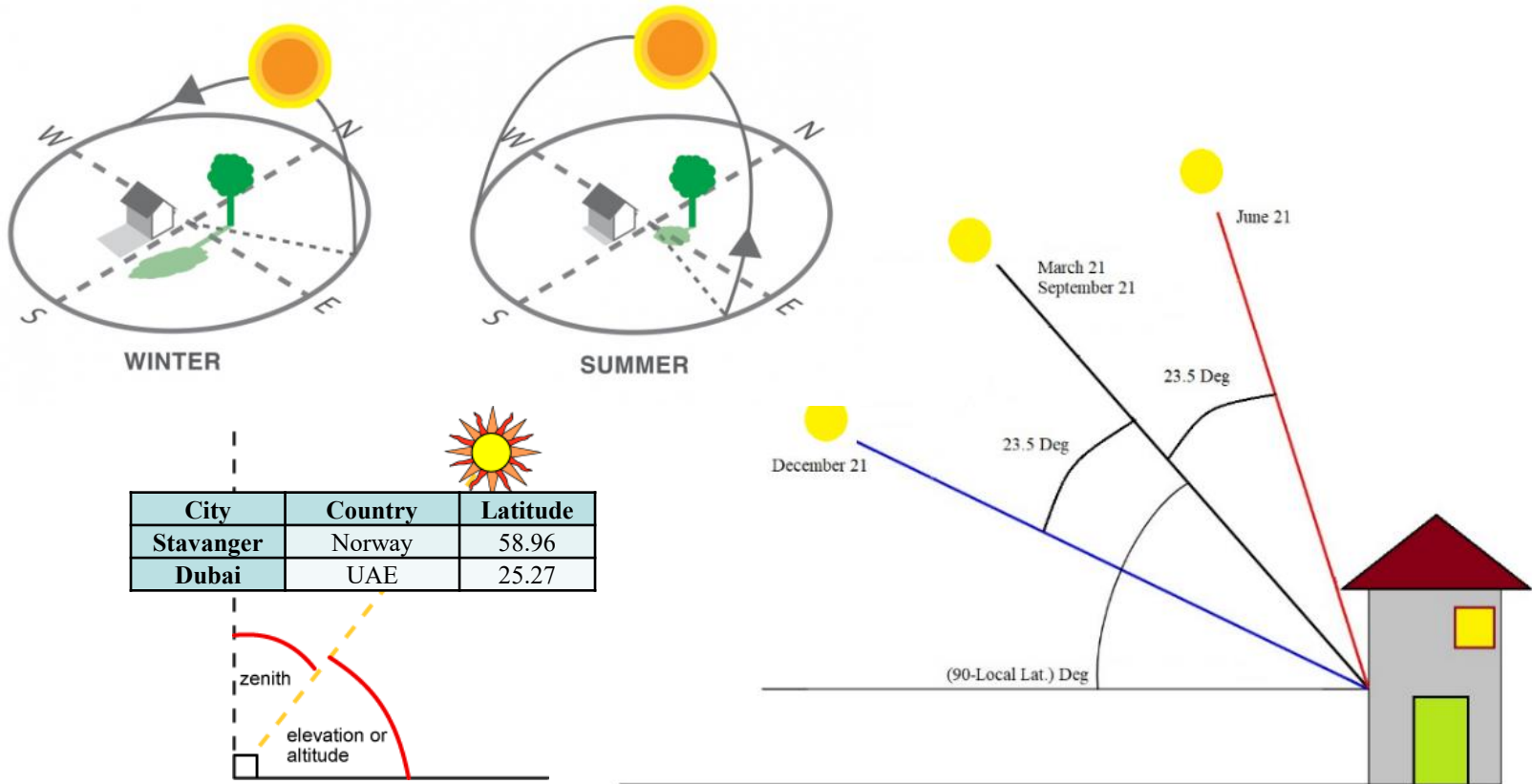
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# Solar radiation components



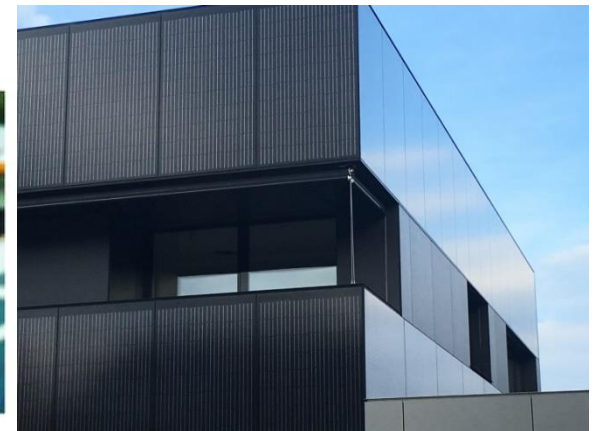
# Sun path in the sky



# BIPV

BIPV is a PV technology that can be integrated to the building with two function:

- Energy producer
- Building skin

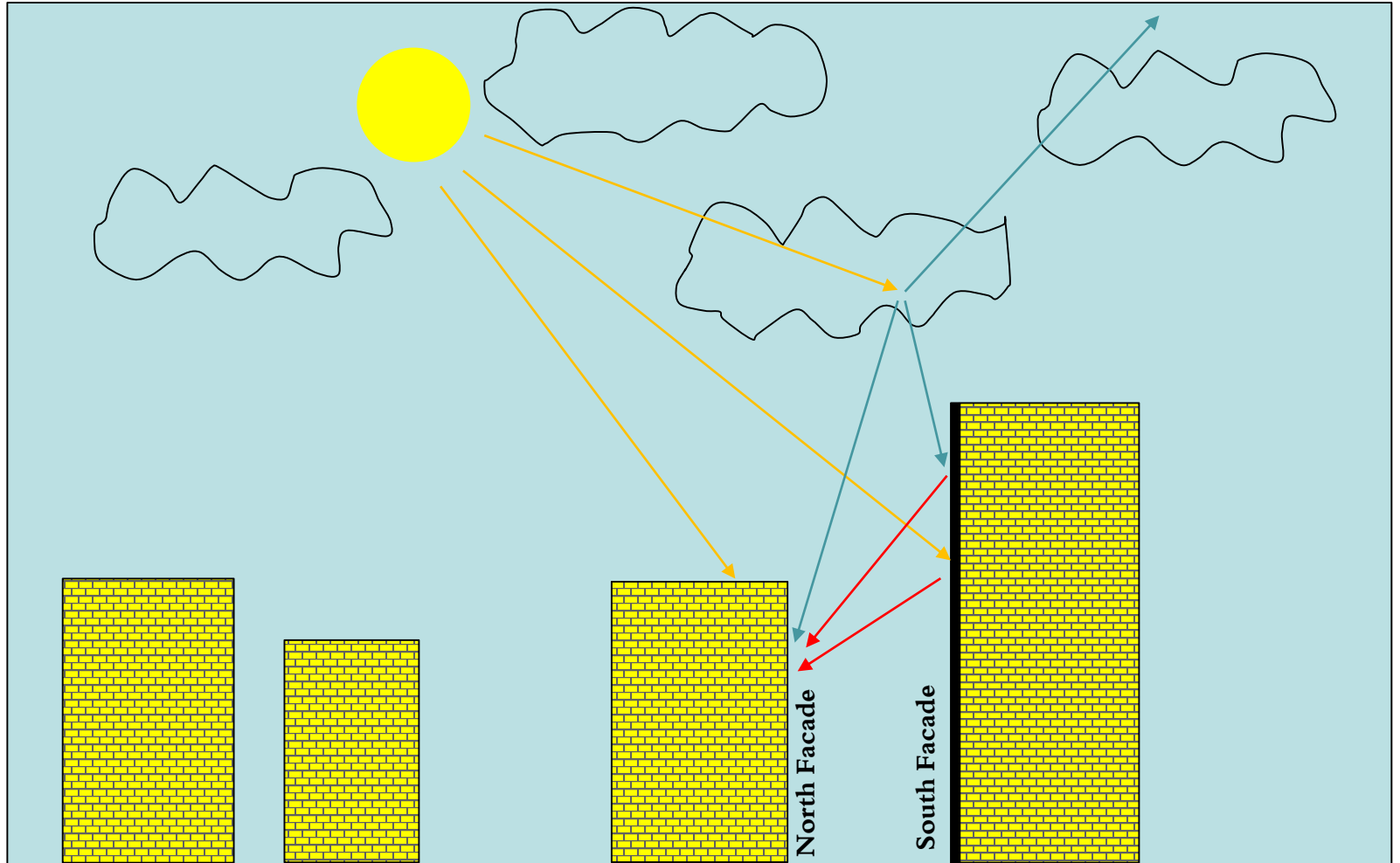


# Solar radiation; Stavanger vs Dubai

City	Orientation	Annual Radiation kWh/m2	Direct	Diffuse	Reflected
Stavanger	South	751	47.4%	41.8%	10.8%
	East	535	39.2%	48.2%	12.6%
	West	513	37.8%	49.4%	12.8%
	North	254	5.9%	73.7%	20.5%
	Roof	831	39.8%	60.2%	0.0%
Dubai	South	1,344	52.3%	32.2%	15.5%
	East	1,182	51.3%	35.8%	12.9%
	West	1,154	50.7%	36.1%	13.2%
	North	433	11.2%	66.5%	22.3%
	Roof	2,311	68.0%	32.0%	0.0%

City	Orientation	Share of the area	Walls compared to Roof
Stavanger	South	26.0%	90.3%
	East	18.6%	64.4%
	West	17.8%	61.7%
	North	8.8%	30.6%
	Roof	28.8%	
Dubai	South	20.9%	58.1%
	East	18.4%	51.2%
	West	18.0%	49.9%
	North	6.7%	18.7%
	Roof	36.0%	

# Impact of urban areas like Stavanger

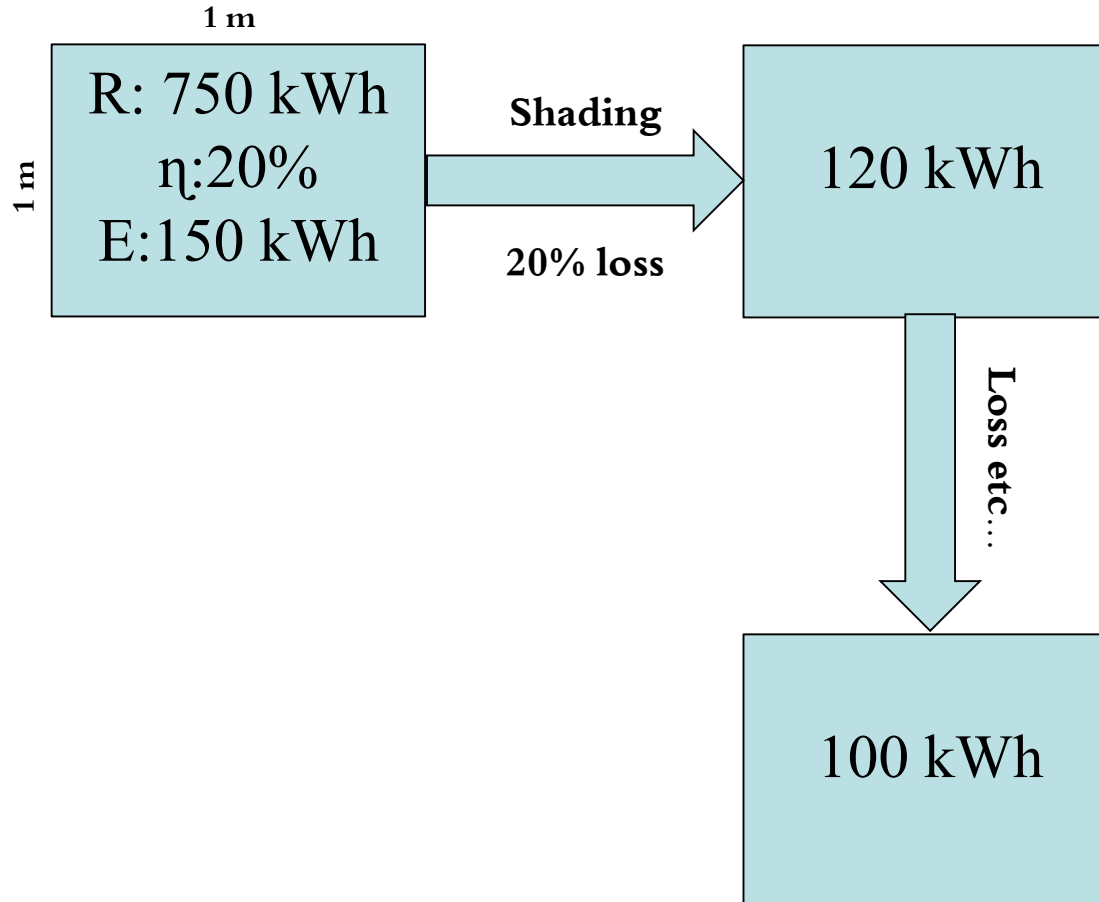


## Economic feasibility

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1. BIPV has two function in a building.
  - Building skin
  - Energy producer
2. It is in the nearest distance to the end-user
  - No need for investment to extend the transmission lines
  - No transmission line and distribution losses.
3. It is a clean energy (free carbon)
  - No social cost of carbon (SCC).

# Feasibility?





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