

# **Agricultural and Plantation Residues for Sustainable Social and Economic Progress of Villagers**

*H. N. Sharan*

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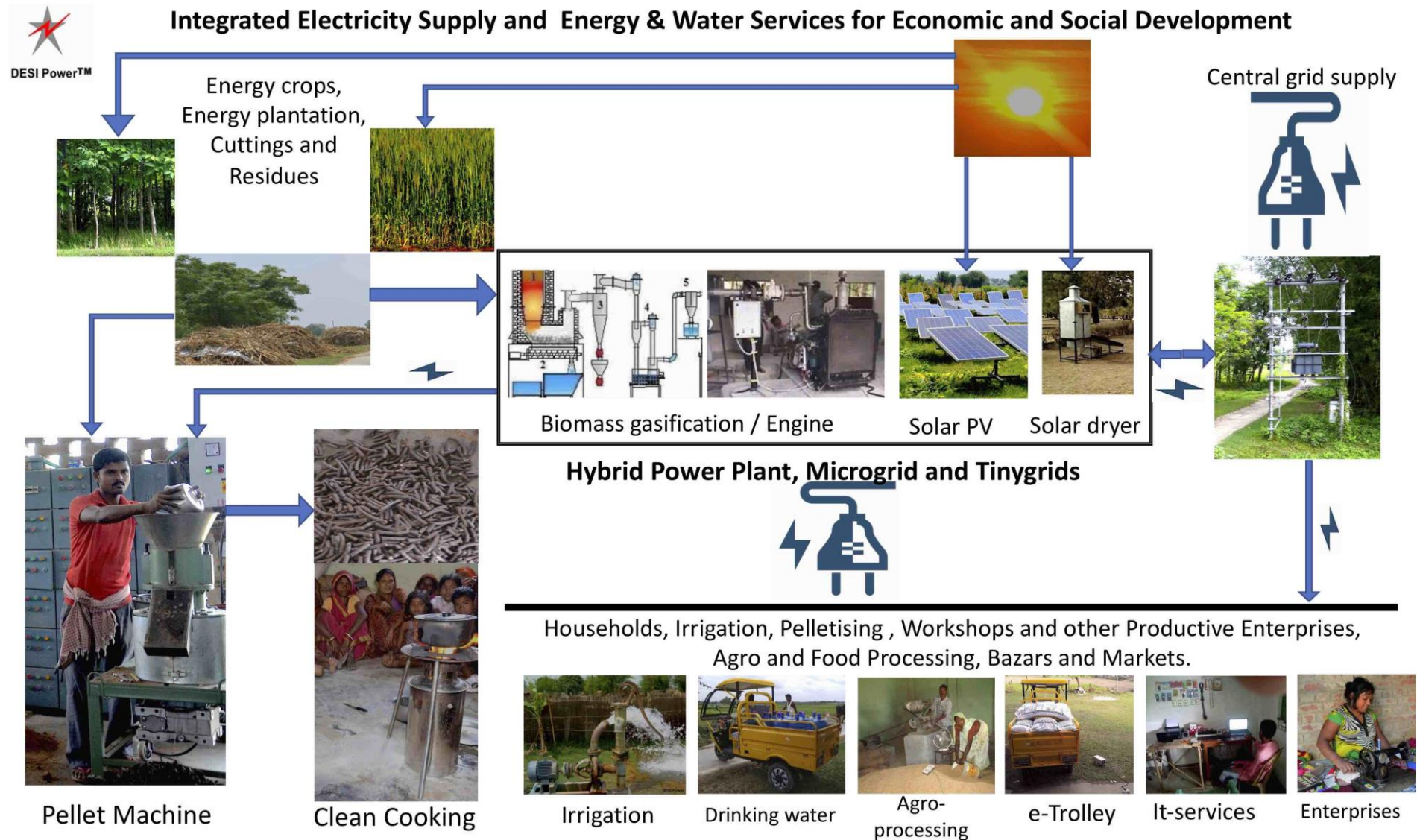
*Adequate quantities of agro-residues are available for meeting the needs of clean cooking of most of Indian villagers.*

*In addition to clean cooking fuel, hybridising agro-residues and other suitable local renewable energy sources can provide power and energy services for social and economic development of villagers.*

Agro-residues for producing pellets and using them for clean cooking (For 164 million families living in villages in India)		
Potential pellet production from total agro-residues		
Total agro-residues potentially available in India	mill.t/y	200
Argo-residues for making pellets	kg ar/kg p	1.1
Pellet production from total agro-residues	mill. t-p / y	182
Power generation potential using total available agro residues		
Specific power consumption of agro-residues for producing pellets	kg-p/kWh	1.25
Annual hours of generation	h/y	5'000
Power potential using total available agro residues	kW	29'090'909
	MW	29'091
Demographic Data India. Source: Wikipedia		
Demographic Data India: Wikipedia	Year	2020
Total population	millions	1370
% in villages	%	60%
Pop. In villages	millions	822
Avg. per/family	No/fam	5
No of families in villages	Millions	164
Average pop of villages (assumed)	No.	1500
No. of villages	No.	548000
Pellets for cooking energy for all village families (5 persons/family @ 0.5 kg-p/person per day )		
Daily consumption of pellets / fam	kg-p/d.fam.	2.5
No. of days / y	d/y	365
Annual consumption of pellets / fam	kg-p/y.fam	912.5
Annual consumption of pellets / fam	t/y.fam	0.9125
Total No. of families in Indian villages (as above)	million	164
Pellets needed for cooking by all families	mill.t-p/y	150
Pellets needed for generating power for producing pellets		
kWh needed to produce pellets (from pellet sheet)	kWh/kg-p	0.075
kWh needed to produce pellets	kWh/y	11'251'125'000
Running hours of m/c	h/y	2640
Power for Pelletising	MW	4'262
Power for Pelletising (% of total potential of power from agro-residues)	%	15%

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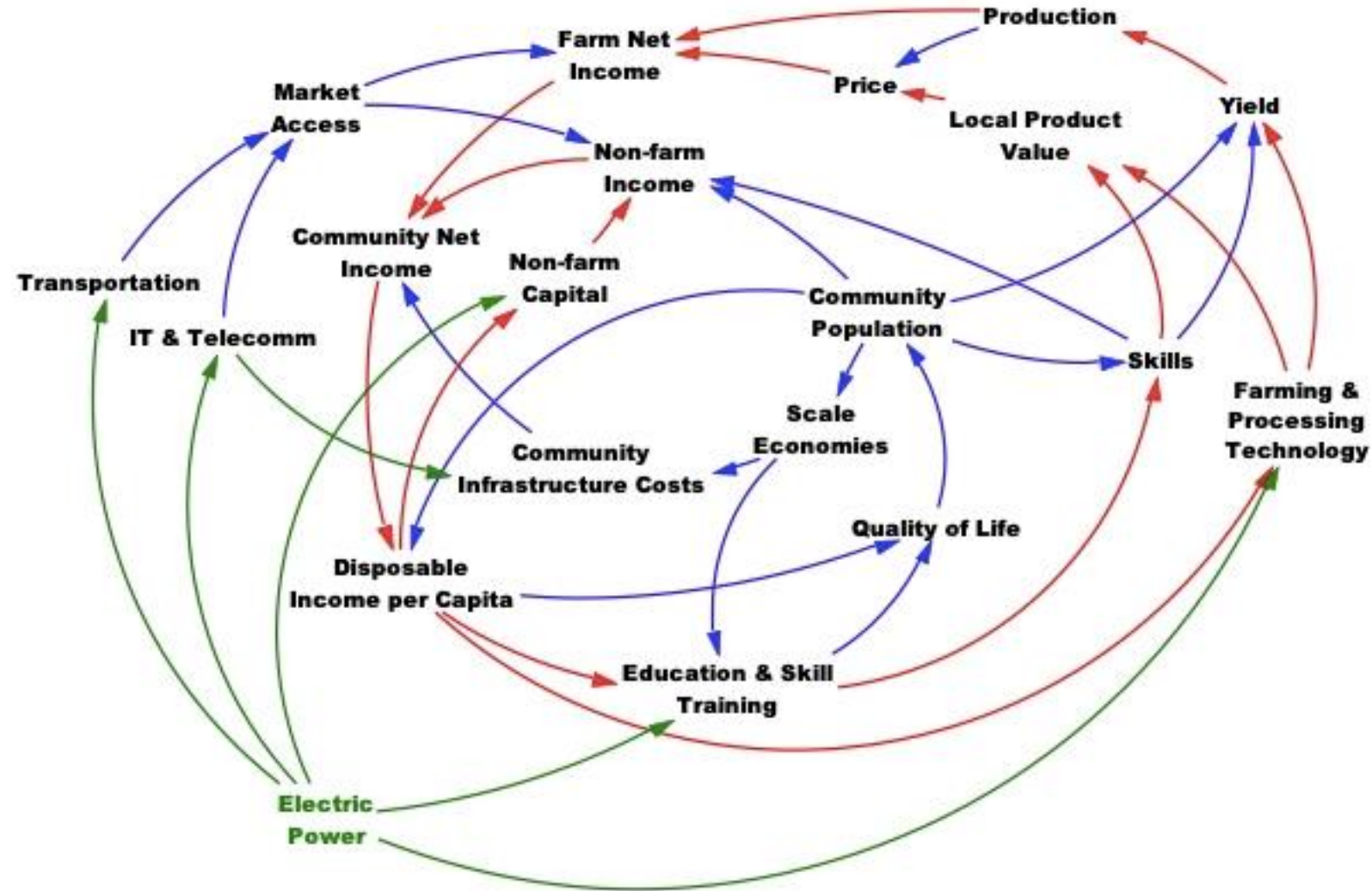
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*Example of the Modelling Process for Planning a Complex System using Vensim Software*

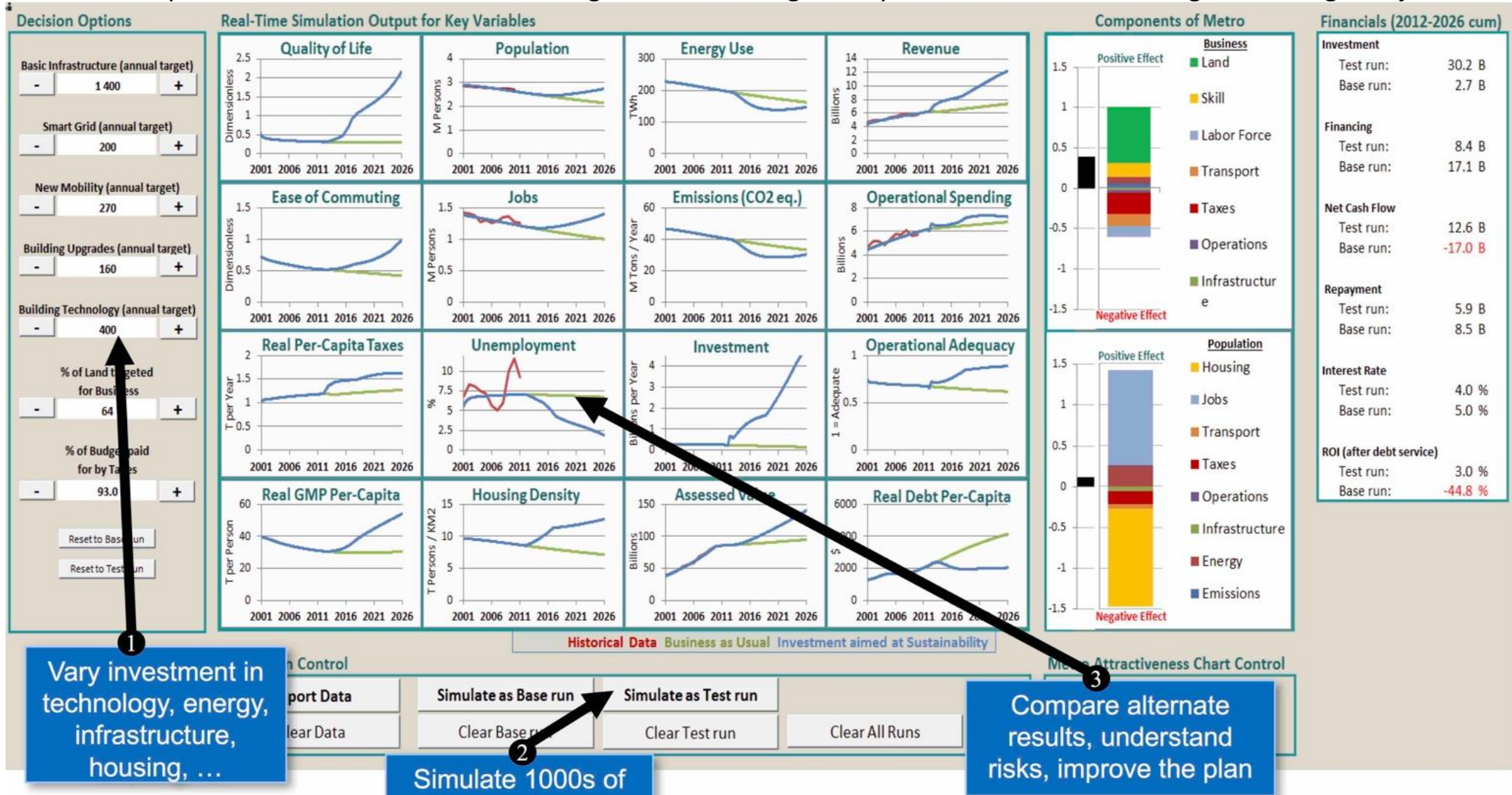




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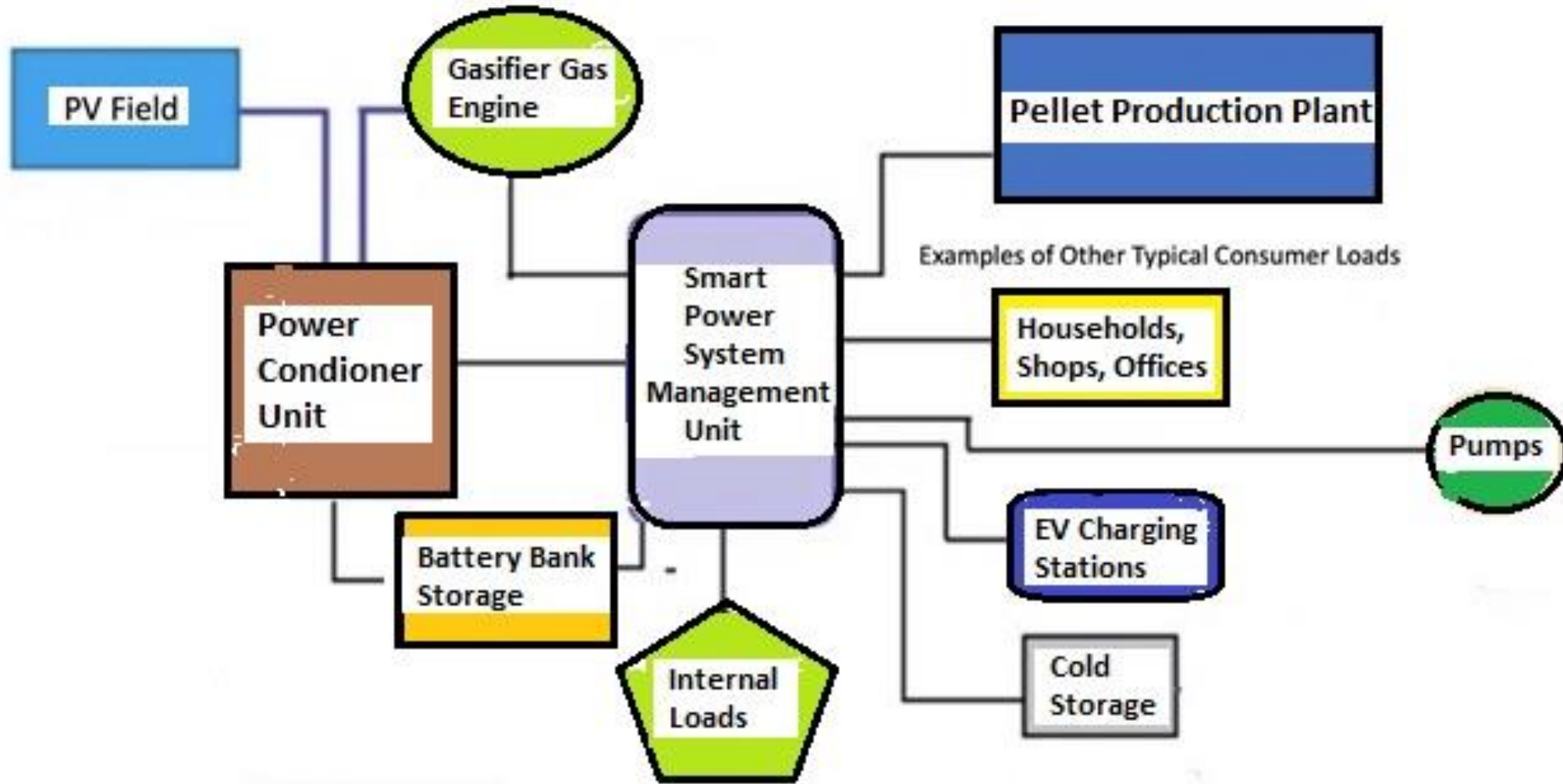
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An Example: Results of Simulation Modelling for the Planning of a Hybrid Power Plant for Integrated Village Projects



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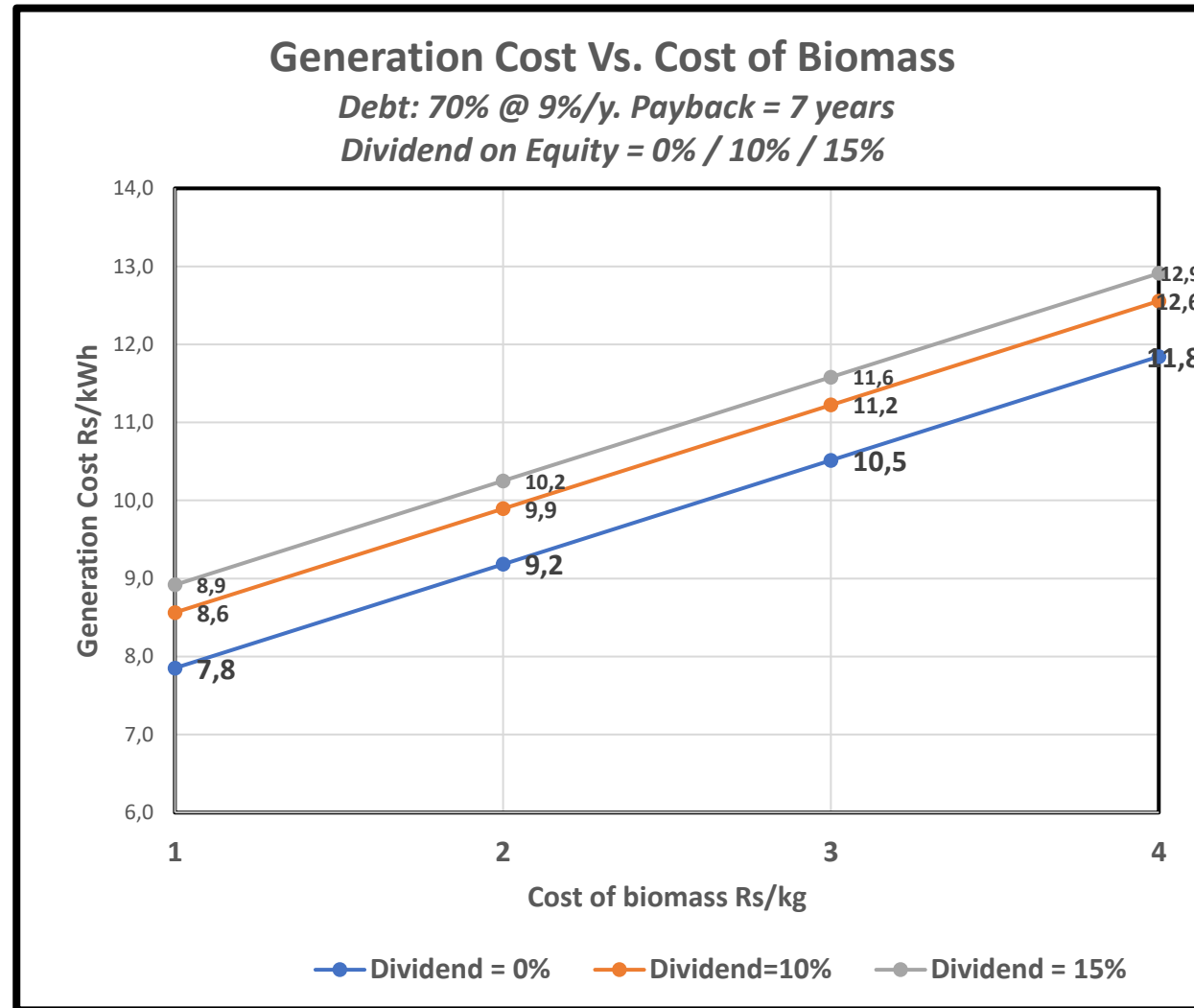
*The example given below is of a non-optimised Hybrid Power Plant and a Pelletising Unit for a Clean Cooking Fuel Business.*

<b>Biomass PV Hybrid Power Plant of (65 kW + 10 kWp) rating.</b>
<b>Consisting of:</b>
<ul style="list-style-type: none"><li>• Gasifier, PG Engine and Auxiliaries</li><li>• PV Plant</li><li>• Battery Bank</li><li>• Auxiliary Systems</li><li>• Microgrid Distribution Network</li></ul>
<b>Not included:</b>
<ul style="list-style-type: none"><li>• Smart Control System</li></ul>
<b>Pelletising Plant Complete: 500 kg-pellets/h</b>

**Total Project Cost (used in the example here):  
9.5 million Rs / 106'000 Euro**

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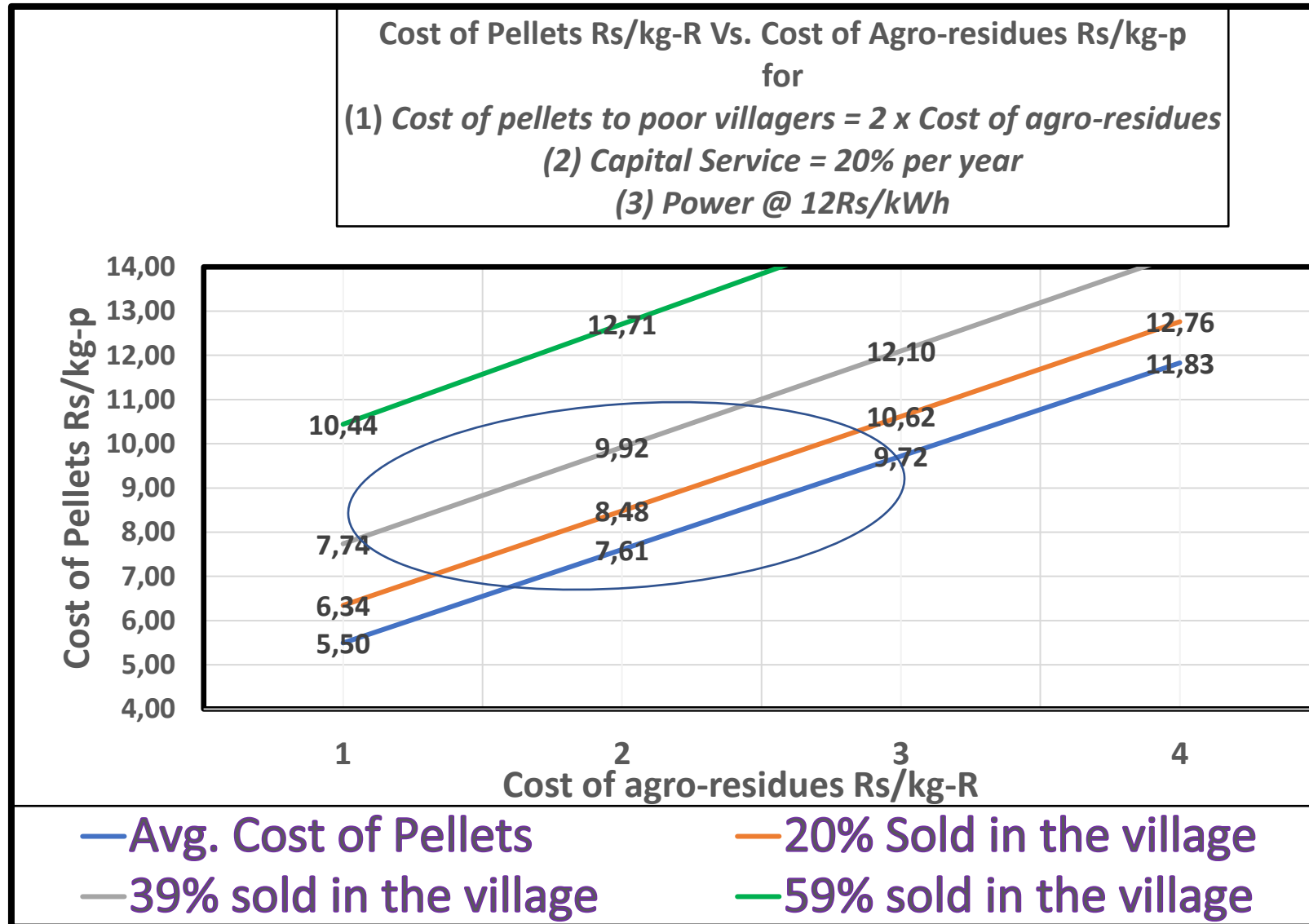
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## Conclusions

*The most effective, profitable and sustainable way of recycling of agro-residues is their commercialisation as pellets for clean cooking.*

### Our studies show that:

- Adequate quantities are available for meeting the needs of most of Indian villagers.
- Pellets used with energy efficient stoves can compete locally with other source of clean cooking (induction cooking, natural gas, LPG, clean biofuels and others under an equitable policy regime.
- Integrated with local power generation and micro grids, they will eliminate pollution and smoke-linked diseases, create local jobs, provide water services for farmers and electricity for households, shops and productive usage, e-transportation and IT services.

## Conclusions

*The most effective, profitable and sustainable way of recycling of agro-residues is their commercialisation as pellets for clean cooking.*

**Our analysis shows that large-scale commercialisation will not be achieved unless:**

- Integrated projects are planned and optimised for local conditions.
- Commercial-pilot projects are optimised, built and successfully operated in different regions of the country.
- The most promising locations for commercial-ilot projects are plantations and “Aspirational Villages” in agro-intensive parts of India where some of the poorest Indians live.
- Prospective owners, investors and equipment suppliers are convinced that policy frameworks, regulatory regimes and financing sources will be available for large scale commercialisation if commercial-pilot projects are successful.