

# The Future Transportation with Sustainable Energy



**Gustav R. Grob. F.I.P**

Executive Secretary of the International Sustainable Energy Organization ISEO, Geneva

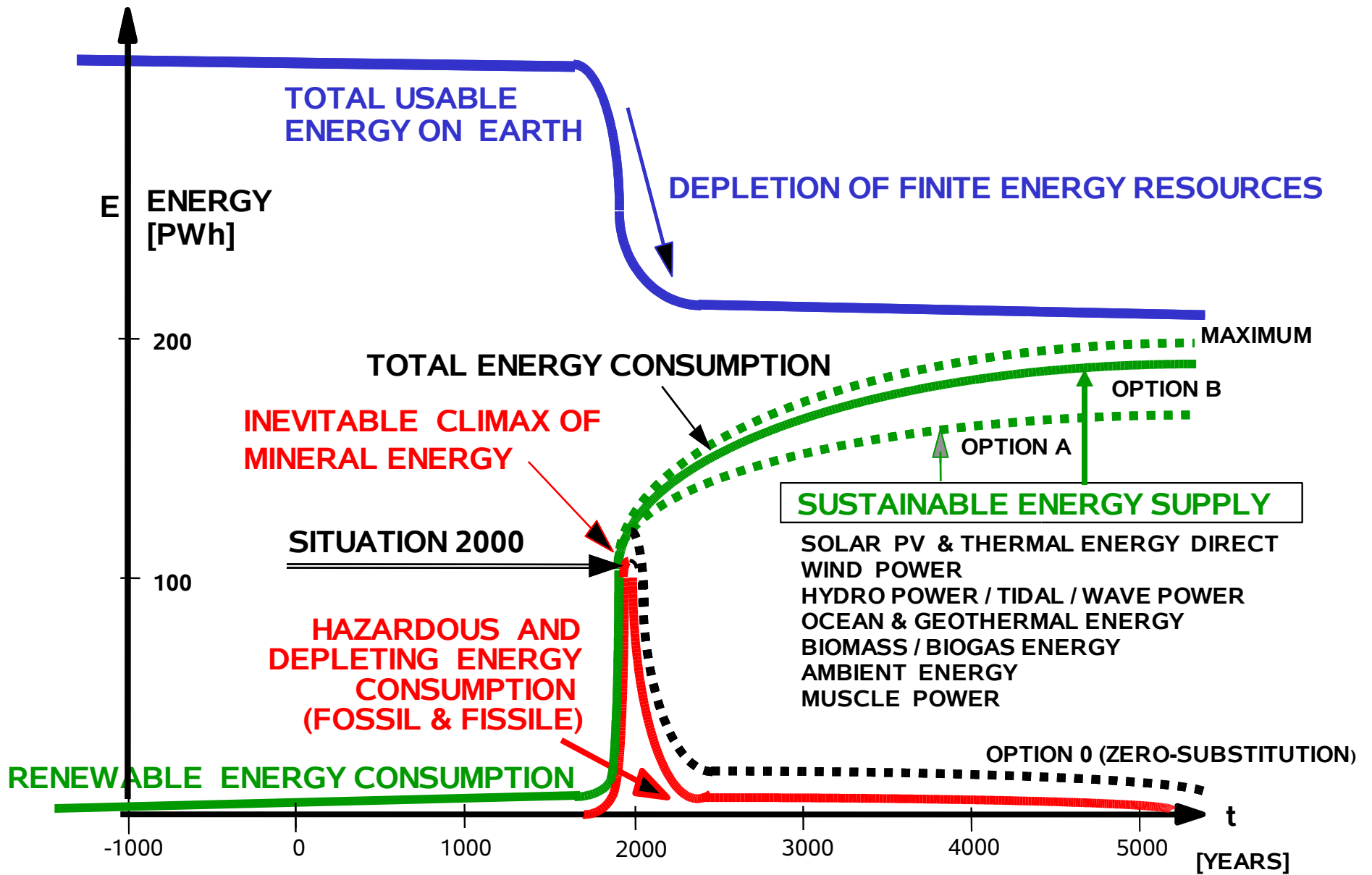
Chairman ISO/TC203/WG3 Energy Systems Analysis & Statistics

Founder Chairman ISO/TC197 Hydrogen Energy Systems

President International Clean Energy Consortium ICEC

# **Energy supply for a growing population is facing fundamental change for three reasons:**

- 1- The economic supply of the mineral energy resources oil and gas is ending in a few decades.
- 2 - Health hazards, risks and global warming caused by emissions from combustion engines.
- 3 - Imperative conservation of the fossil resources for the chemical and metallurgical industries.



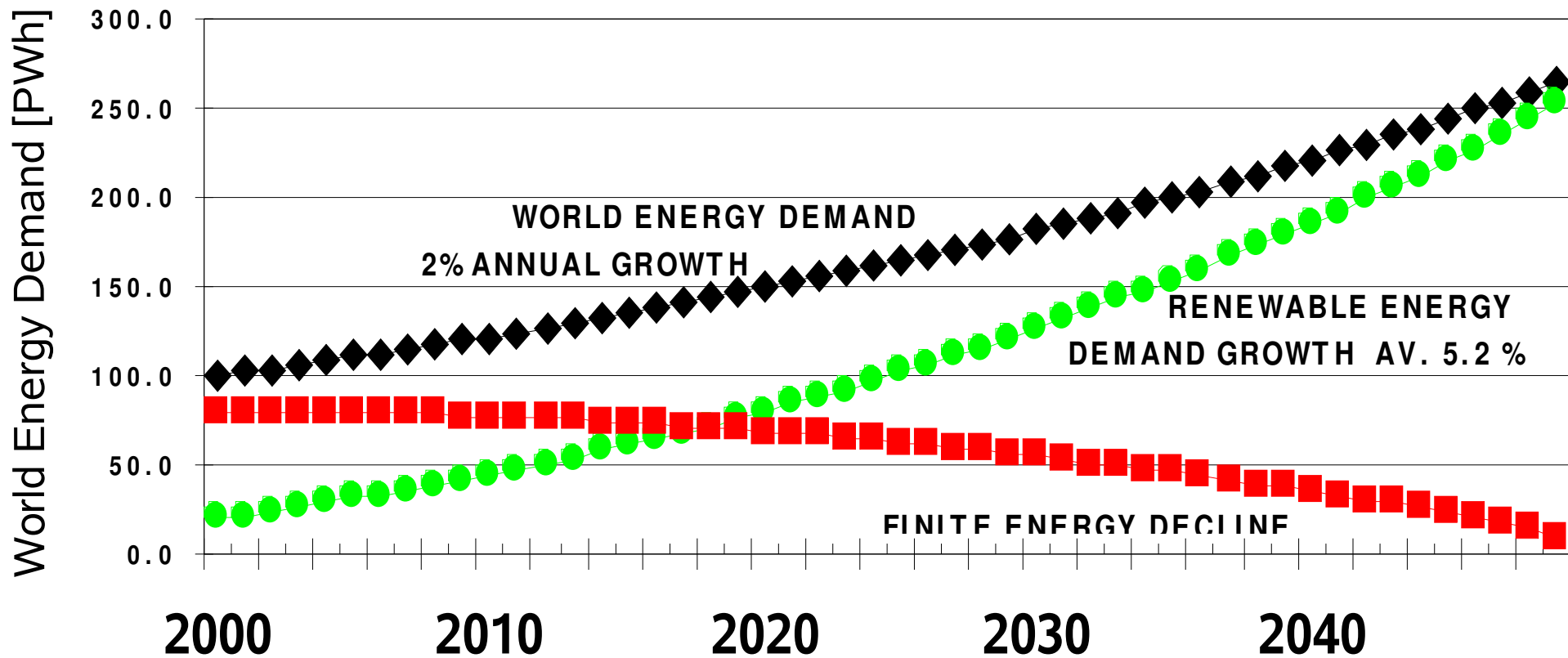
SOURCE : ISEO

# ENERGY HISTORY & FORECAST

**To cope with these serious problems,  
benign, renewable energy systems must  
be multiplied  
to replace conventional combustion**



# WORLD ENERGY SCENARIO 2000 - 2050



Source for Finite Energy Data: ASPO at [www.peakoil.net](http://www.peakoil.net) & Kyoto Protocol

**Wind Power**

**Hydropower**

**Heat Pumps**

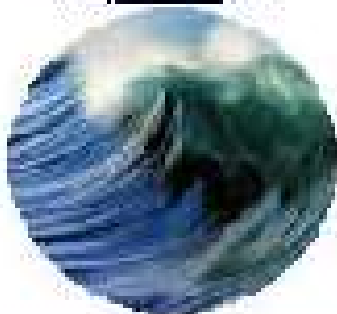
**Solar Energy**

**Bio Energy**

**Ocean Energy**

**Clean Vehicles**

**Geothermal Energy**



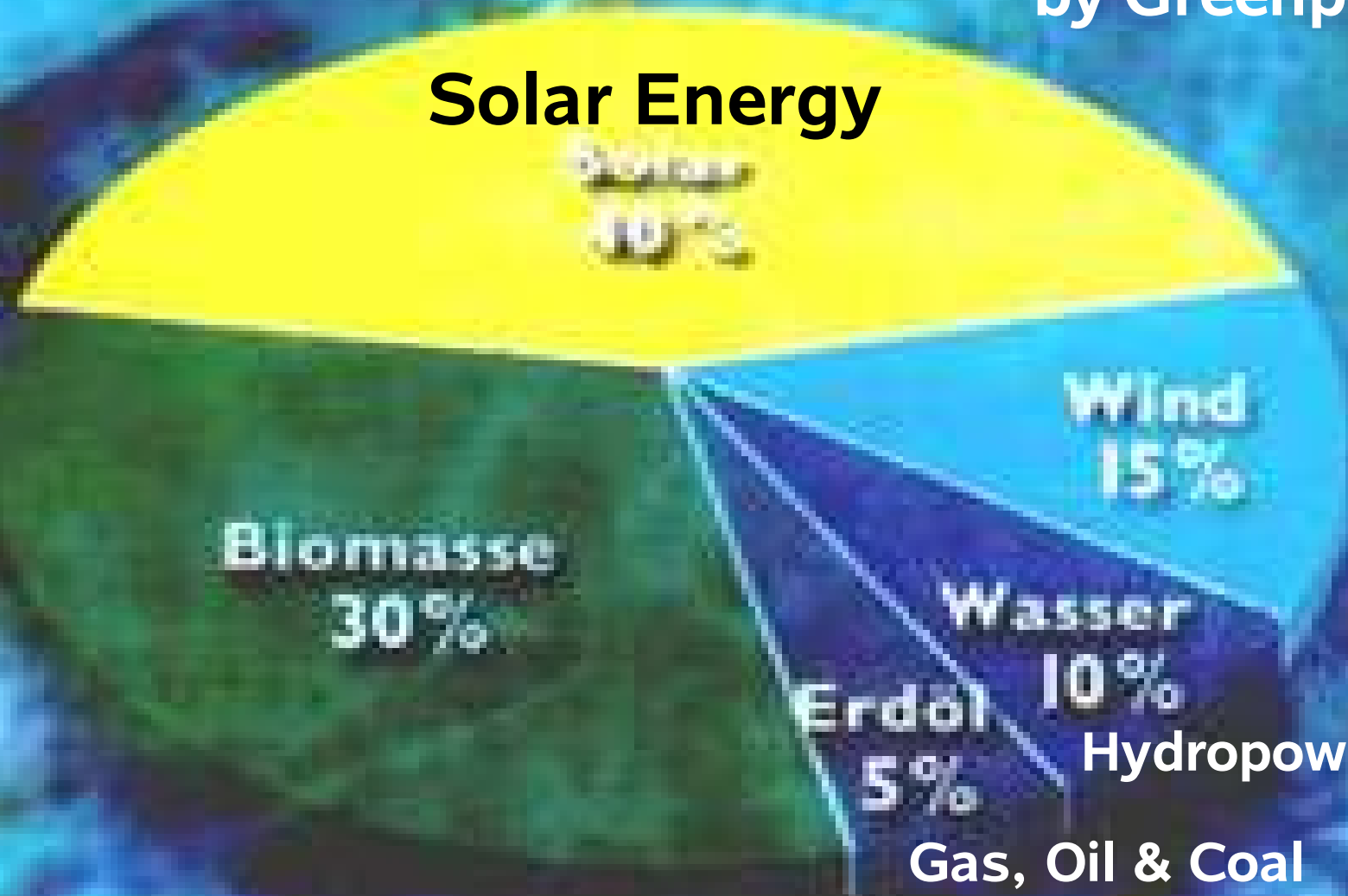
<u>Energy Option</u>	<u>Immediately Feasible</u>	<u>Theoretical Potential</u>
- Bio energy	50	78
- Hydropower	8	14
- Geothermal Electricity Conventional	2	} 388
- Geothermal Electricity Hot Dry Rock	20	
- Geothermal Heat	4	
- Wind Power	53	160
- Solar Power PV	6	} 435
- Solar Thermal Power	40	
- Solar Active Heat	20	
- Solar Passive Heat	10	} 202
- Ocean Energy	15	
- Heat Pumps	10	50
- Muscle Energy	1	10
- Novel Energy Technologies (R&D)	<u>100</u>	<u>200</u>
<b>Total RE potential</b>	<b><u>339 PWh/year</u></b>	<b><u>1537 PWh/year</u></b>

# Conclusions of the ISEO Energy Study

1. There is more affordable renewable energy available on Earth than humankind ever needs at the foreseeable population growth rate.
2. Most renewable energy systems are competitive with the depleting non-renewable sources - even more so, if the full costing “polluters-pay” principle is applied.
3. All nations are able to become energy self-sufficient with renewables, and thus can drastically reduce pollution by cleaner, more efficient power plants and transport modes.
4. The remaining mineral energy resources can and must be conserved for higher added value purposes in the chemical and metallurgical industries.

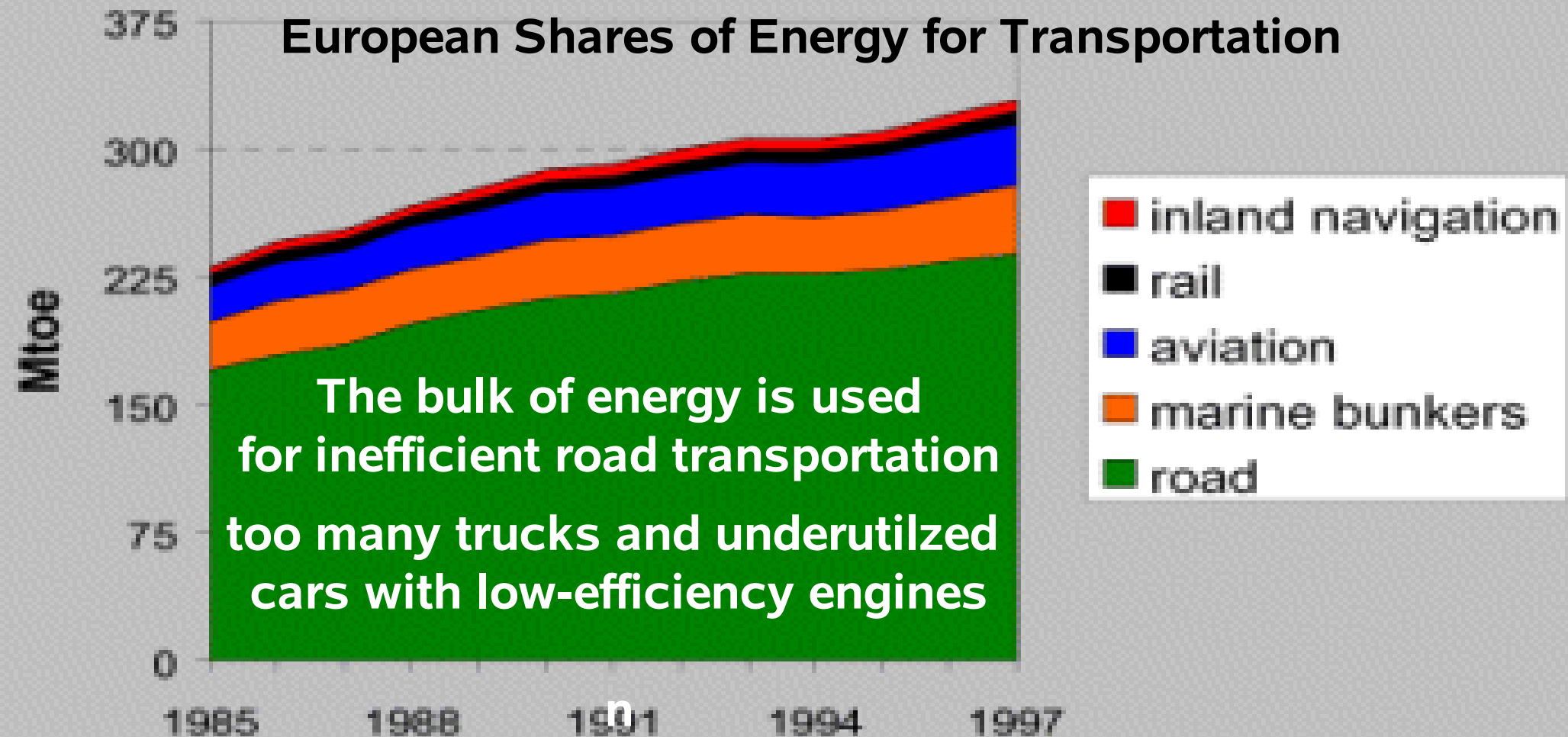
# ENERGIESZENENARIO 2050

by Greenpace



Geothermal and Ocean Energy are missing

# Transportation absorbs over 1/3 of World Energy Production i.e. over 50 % of World Oil Production



**SUSTAINABLE  
TRANSPORTATION  
OF THE FUTURE**

**Clean Rapid Mass Transit** and **inter-modal freight systems** are indispensable for the efficient flow of people and goods in highly populated regions, but also **clean** and **safe individual transport** is required to satisfy the needs of humans living or working in remote, scattered locations and for their leisure time.

Solutions are **electric trains** for goods and people, **clean fuel trucks** and **ships** for inter-modal transportation, **cleaner aero-planes** and **efficient 2, 3 & 4-wheelers** driven by **clean fuels or electricity** from **RE** sources.

# Rapid Mass Transit Systems





## People Transportation



**must evolve** towards combined Road-Rail Mass Transit Systems. **Excellent example:** the **Electric Swiss Rail Network 2000** saving unproductive time of travellers, traffic fines, parking and fuel cost, pollution, reducing traffic congestion and improving social life among the passengers in transit

# Example: **Electric Schoolbus with Supercaps**



Inductive Re-Charging

## **Individual Transport**

**is, however, one of the basic human urges.**

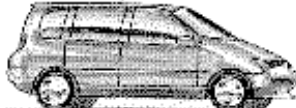
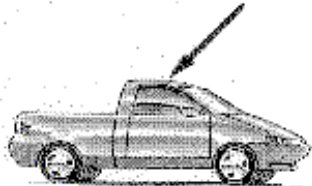
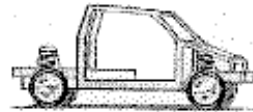
**It must be satisfied for professional and leisure purposes. I characterized the car of the future 1992 in Rio as follows:**

**Comfortable, Light, Zero-Pollution,  
Quite, Safe, Long-Life, Recyclable,  
Low Maintenance Cost  
& Modern Navigation System**

# Proposed Electric Vehicle Platforms

105 Inch Wheelbase (2667mm)

90 Inch Wheelbase (2286mm)



Mid-Sized Pick-Up

Mini-Van

2-Door Hatchback

2-Door Wagon

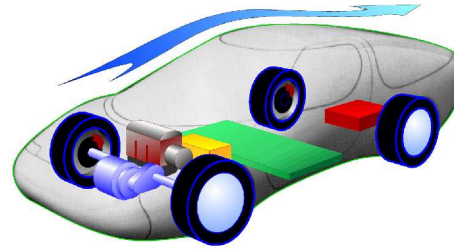


4-Door Sedan



2-Passenger Coupe

# EV Concept



# Solar Car



# Battery Charging



The Toyota electric Rav.e4



0 to 60 mph  
1/4 mile  
Range at 40 mph

4.1 seconds  
13.2 seconds  
100 miles

200 horsepower  
20 kW on-board charger  
Powerful and slip regeneration

AC Propulsion's TZero



The electric GWfz

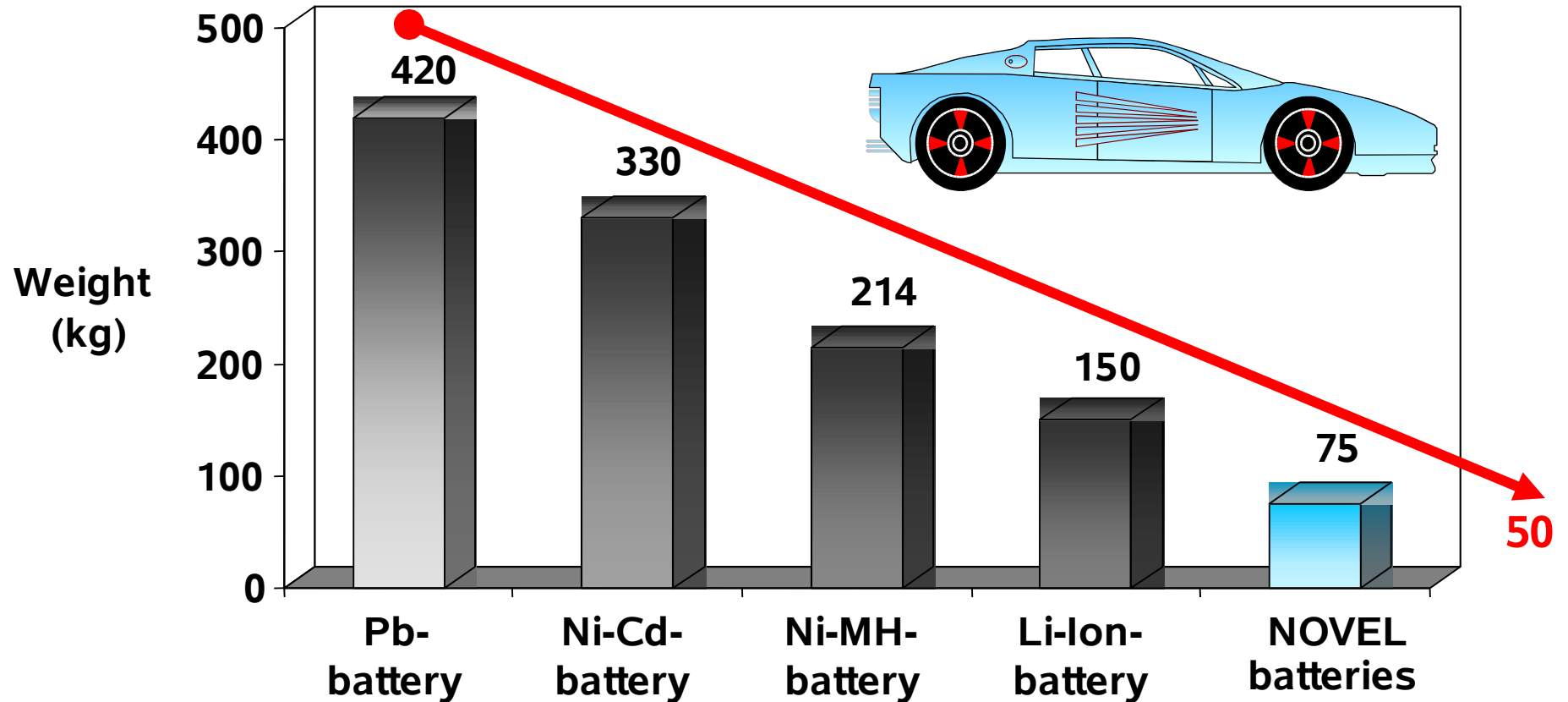


The Citroen electric Berlingo Van



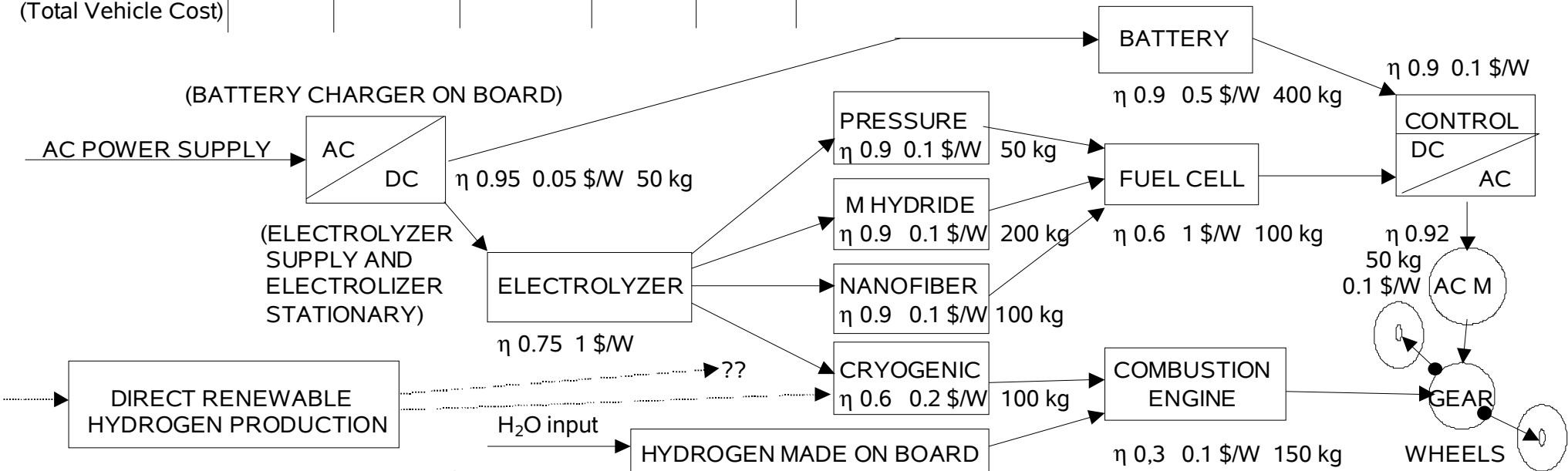
# Future Electric Cars - Long Range & Long Life

## Comparison of 15 kWh Batteries by Weight



# COMPARISON OF CLEAN VEHICLES (40 kW; 240'000 km over 6 years)

Drive Options Criteria	Battery NOVEL	Hydrogen Fuel Cell	Hydrogen * Combustion	* Gasoline Combust.	H2+O2 * HYMOBIL	Remarks
		Amb. Temp. Storage	Cryogenic Storage **	Gasoline Tank	Water Tank	*** AC/DC charger on board the electric car for easier battery charging **** cryogenic H <sub>2</sub> storage boil off loss depending on parking duration the same gear box assumed for all options including energy management, storage and power train
Relative Drive Investment \$/W	0,75	2,35	1,35	< 0.20	0,25	
Energy Cost \$/km	0,03 *****	0,07	0,16	0,15	0,01	***** energy supply at 0,1 \$/kWh or H <sub>2</sub> at 1 \$/L gasoline equivalent
Relative Weight kg	350	250	250	200	220	average weight of energy management, storage and power train
Average Range km	300	400	200	400	1'000+	with one tank filling or one full charge (plus extra charges at stops)
Energy Efficiency %	0,75	0,32	0,13	0,13	> 1	total efficiency over whole energy chain to gear box
E + Cap. Cost \$/km (Total Vehicle Cost)	0,20	0,56	0,46	0,28	0,14	at 6 % interest over 3 years and 240'000 km usage incl. service & spares



Source: ICEC, CH-8055 Zurich / GRG [info2@icec.ch](mailto:info2@icec.ch)

# The Merits of Bicycles and Electric Two & Three Wheelers for Good Health and Congested Areas



# Freight Transportation

**must undergo drastic change towards inter-modal road-rail-barge-freighter transportation by means of standard ISO containers in conjunction with the improvement of the railway network and modern container handling systems**

# Ship-Road-Rail Freight Container Transloading Facility



## **Air Transport**

**> a tough environmental problem <**

**It is responsible for excessive pollution in very sensitive atmospheric layers. It may be resolved by hydrogen jet engines, as demonstrated already in the Eighties, or by air ships lifted by inert gases and propelled by clean fuels**



**Hydrogen Aeroplanes**



**Clean Airships**



**Space Shuttle**



# CONCLUSIONS

- **Clean vehicles, fed by renewable energy** are needed to satisfy individual mobility
- **Clean Mass transport** for people has to take the pressure off traffic congestions
- **Clean inter-modal freight transport** must be developed at a much faster pace
- **Air transport** must become **cleaner, quieter**

**Innovation coupled with huge investments  
can and will fulfil these tasks**



## RECOMMENDATIONS

- ❖ **Accelerate the development of efficient, quiet and non-polluting drive systems**
- ❖ **Implement more electric rapid transit & inter-modal freight transport systems**
- ❖ **Design and manufacture clean, lighter, quieter, safer, recyclable vehicles**
- ❖ **Implement clean, renewable energy supply systems at a much faster pace !**

# International Sustainable Energy Organisation for Renewable Energy and Energy Efficiency

ISEO, POB 200, CH-1211 Geneva 20 - Tel: +41-22-910-3006 - Fax: +41-22-910-3014  
**Preparatory Commission** e-mail: info@uniseo.org - http://www.uniseo.org



[www.uniseo.org](http://www.uniseo.org)

[Background & Reasons for ISEO](#)

[Appeal to all Nations](#)

[About the ISEO Mandate](#)

[Principles of ISEO Operation](#)

[ISEO Organization Chart](#)

[ISEO Network & Web-Links](#)

[Statute of ISEO](#)

[Global Energy Charter](#)

[Blueprint for Clean Energy](#)

[Implementation Tools-ISO/IEC](#)

[ISEO News and Events](#)

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