designing for the transition
PROBLEM STATEMENT

Can a housing system be designed to cope with the rapid housing demand of an oil boom in rural North Dakota and be maintained or removed when the boom subsides?
CORE CONCEPTS

Provide a temporary housing development to accommodate oil field employees or other rural workforces and their families.

The project will embody a self-sufficient approach in an effort to relieve rural communities from an overwhelming population increase of migrant workers.

The temporary housing will exist with little or no aid from outside infrastructure, making it able to be implemented anywhere there is a demand.

Construction methods and materials will be examined to produce a housing system which is not only easily and efficiently assembled and disassemblable, but also directly reusable for future application.

Sustainable products and systems will allow for the generation of renewable energy and make self-sufficient living possible.
PORTABLE LIVING UNIT
CONSTRUCTION SEQUENCE
EXTERIOR PERSPECTIVE
Operable exterior solar shades on the south and east facades help regulate solar heat gains and also act as a light shelf bouncing light into the bedroom spaces.

Transome and skylight windows on the north side of the house bring natural light into the dining and kitchen spaces.

Elevated canopy supports photovoltaic and solar thermal panels and also collects rainwater.

Operable exterior solar shades on the south and east facades help regulate solar heat gains and also acts as a light shelf bouncing light into the bedroom spaces.

Adjustable footings allow flexibility and adaptation to any terrain.

Raised floor system houses electrical, plumbing and HVAC components.
PASSIVE DAYLIGHTING
Noon sun in Summer

Noon sun in Winter
ACTIVE SYSTEMS

• SOLAR HOT WATER HEATING
• SOLAR ELECTRIC PHOTOVOLTAIC SYSTEM
• RAIDIANTE HEATING
SOLAR WATER HEATER

100% HOT WATER HEATED BY SOLAR THERMAL COLLECTION

Solar Radiation

WATER MAIN (MUNICIPAL)

ELECTRIC BOILER

RAINWATER TREATMENT

BR SINK
SHOWER/BATH
KITCHEN SINK
DISHWASHER
WASHING MACHINE

TOILET

BLACKWATER

GREYWATER

TO WASTEWATER TREATMENT

RAINWATER TREATMENT
ROOF COLLECTION AREA: 1,050sf

SOLAR COLLECTION: 230W Solar Photovoltaic Module
Polycrystalline silicon cells
BP3210T

1,050sf collection area divided by 17.5sf/panel
= 60 panels
x 230W/panel
= 13,800W (13.8 kW)

Average production for 5 hours per day
13.8kW x 5hrs x 365days
= 25,185 kWh/yr.

Annual electricity usage: Household average per month = 1,150 kWh
1,150kWh x 12mo. = 13,800 kWh/yr.

PRODUCTION: 25,185 kWh/yr. = 182% of consumption

Excess AC power generated is sold back to the grid and used by the utility company. The house will use electricity from the city grid during non-solar harvesting times.
RAINWATER HARVESTING

Average precipitation: 18”/ year
Collection roof area: 1,600 sf

Water collection:

\[ \text{SF} \times \text{inches/year} \times 0.5618 = \text{gallons/year} \]

\[ 1,600 \text{ sf} \times 18”/\text{yr.} \times 0.5618 = 16,180 \text{ gallons/year} \]

\[ \frac{16,180 \text{ gallons/year}}{52 \text{ weeks}} = 311 \text{ gallons/week available} \]

5 months draught (<1 in. rainfall)
\[ \times 4 \text{ weeks/month} \]
\[ = 20 \text{ weeks} \]
\[ \times 311 \text{ gallon/week budget} \]
\[ = 6220 \text{ gallon supply for draught} \]

Consumption:

29.5 gallons/day average per person
\[ \times 4 \text{ people per household} \]
\[ = 118 \text{ gallons/day} \]

\[ 118 \text{ gallons/day} \times 365 \text{ days} = 43,070 \text{ gallons/year consumed} \]

16,180 gallons/year collection = 37% of consumed water
RAINWATER HARVESTING SYSTEM

RAINWATER

DEBRIS FILTER

CISTERN

PRESSURE PUMP

PRESSURE TANK

PARTICLE FILTERS

CARBON BLOCK

ULTRAVIOLET LIGHT FILTERS

PRESSURE PUMP

HOLDING TANK

DOMESTIC USE

SOLAR THERMAL

HOT WATER

WATER MAIN
(MUNICIPAL)

GREYWATER

WASTEWATER TREATMENT SYSTEM

20' and 40' Shipping Container Biofilters

SC-20 treats 5,300 gpd = approximately 40 people (10 homes)

SC-40 treats 10,600 gpd = approximately 80 people (20 homes)

BLACKWATER SEWER

BLACKWATER

GREYWATER

WC